COMMONWEALTH OF PENNSYLVANIA

SUPPLEMENT TO 1982 REVISION OF THE STATE IMPLEMENTATION PLAN FOR OZONE AND CARBON MONOXIDE FOR THE PENNSYLVANIA PORTION OF THE PHILADELPHIA AIR QUALITY CONTROL REGION

June 20, 1983

Bureau of Air Quality Control

Department of Environmental Resources

Supplement to
1982 Revision of the State Implementation Plan for
Ozone and Carbon Monoxide for the Pennsylvanina Portion of the
Philadelphia Air Quality Control Region

This report is a supplement to the "1982 Revision of the State Implementation Plan for Ozone and Carbon Monoxide for the Pennsylvania portion of the Philadelphia Air Quality Control Region". This report contains commitments to attainment of the ozone standard through implementation of an inspection and maintenance program (I/M) and future stationary source control measures. The report demonstrates attainment of the carbon monoxide standard through implementation of I/M and federal new car program.

HISTORY OF 1982 SIP

Under the Clean Air Act Amendments of 1977, state and local governments were assigned the primary responsibility for preventing and controlling air pollution. The Amendments specifically required that all National Ambient Air Quality Standards be attained by December 31, 1982, and that states develop and adopt a State Implementation Plan (SIP) by January 1, 1979 describing the actions that would be taken to accomplish this goal. However, the Amendments also provided for extensions until 1987 for attainment of the standards for carbon monoxide (CO) and ozone in cases where the 1982 deadline could not be met despite the implementation of all reasonably available control measures for stationary and mobile sources. In the event that such an extension was granted, the Amendments furthermore required that a revised SIP be prepared and submitted to the U.S. Environmental Protection Agency (EPA) by July 1, 1982 demonstrating attainment of the standards as expeditiously as practicable but not later than 1987.

The Commonwealth of Pennsylvania submitted a SIP revision for the entire State in 1979. The Commonwealth requested extensions of the ozone attainment date for the Philadelphia, Pittsburgh, and Allentown regions until December 31, 1987. For CO, extensions were requested for Philadelphia (until June 30, 1983) and Pittsburgh (until December 31, 1985). EPA conditionally approved the 1979 SIP on May 20, 1980. The EPA, after receiving supplemental information submitted by the State, fully approved the SIP.

During 1981 and 1982, the Department developed a revision to the SIP. This work was done in conjunction with the Delaware Valley Regional Planning Commission (DVRPC), the Philadelphia Air Management Services (AMS), and other participating agencies. Public hearings were held by DVRPC on March 30 and April 15, 1982. On June 30, 1982, the Commonwealth submitted the 1982 SIP revision required by the Clean Air Act. This SIP revision updated the emission inventories, modeling, attainment demonstrations, and transportation control measures.

On February 3, 1983, the EPA published a notice in the Federal Register proposing to disapprove portions of the SIP and approve other portions. The Federal Register notice states:

EPA is proposing the disapproval of the following portions of Pennsylvania's 1982 Ozone and Carbon Monoxide SIP:

1. The public hearing for the entire SIP.

2. The inspection/maintenance program (statewide) for both ozone and carbon monoxide in all areas.

3. Portions of the ozone plan for the southeastern Pennsylvania area, specifically:

    a. Demonstration of attainment/modeling.

    b. Reasonable further progress.

    c. Stationary source control strategy.

EPA is proposing the approval of the following portions of the southeastern Pennsylvania SIP:

1. Emission inventory.

2. Transportation control strategy.

3. Other additional requirements.

4. Carbon monoxide plan (except for the I/M program).

OZONE

Air Quality: The EPA has established a National Ambient Air Quality Standard for ozone at 0.12 parts per million (ppm). The air pollution control agencies maintain eight ozone monitoring sites in the Philadelphia region. Exceedances of the ozone standard are regularly measured at each site. Table 1 lists the sites and the number of exceedances at each site.

Table 1

Number of Exceedances of Ozone Standard
at Selected Monitoring Sites

Monitor Site	1978	1979	1980	1981
New Jersey				
Somerville	4	4	2	3
Camden Laboratory	10	8	16	6
Trenton	4	4	16	7
Pennsylvania				
Bristol	11	8	20	4
Chester	16	9	26	6
Norristown	19	8	30	6
N.E. Philadelphia	13	6	14	4
Roxborough	3	7	8	3
S.E. Philadelphia	8	1	0	N.A.

This table shows that (except for 1980) there has been a decrease in the number of exceedances at the sites. Significant variability from year to year occurs due in part to meteorology. Table 2 lists the ozone design value for each station. Ozone design values are generally used to show trends over a number of years. The values in Table 2 show a decrease since 1978.

Table 2

Ozone Design Value
at Selected Monitoring Sites
(parts per million)

Monitor Site	1978	1979	1980	1981
New Jersey				
Somerville	.220	.163	.138	.138
Camden Laboratory	.175	.161	.166	.166
Trenton	.175	.133	.165	.164
Pennsylvania				
Bristol	.215	.203	.196	.178
Chester	.215	.201	.180	.171
Norristown	.199	.196	.180	.178
N.E. Philadelphia*	.19	.19	.18	.17
Roxborough*	.17	.17	.17	.16
S. E. Philadelphia*	.20	.17	.17	N.A.

*Philadelphia maintains data only to two significant figures.

Modeling: In February 1982, DVRPC calculated the percent reduction in volatile organic compound (VOC) emissions that is necessary to attain the National Ambient Air Quality Standard for ozone by 1987. The calculation was based upon the emissions inventory for 1980 and was made using EPA's "Empirical Kinetic Modeling Approach" (EKMA).

EKMA estimates the percent reduction of VOC emissions needed based upon conditions specific to the Philadelphia region. The model relates the maximum hourly ozone concentration recorded at a site downwind of the central business district (CBD) to a column of air which originates at the CBD at 8 a.m. and migrates to the monitoring site. The column begins its journey with a fixed concentration of ozone and ozone precursors (VOC and oxides of nitrogen) stretching from the surface to the nighttime inversion layer. This column is then augmented by local emissions as it moves toward the suburban monitor while it expands with the lifting of the inversion lid. The precursors undergo a complex series of chemical reactions throughout the day which produce ozone. The EKMA results are then used to estimate the VOC emission reduction that is necessary to attain the standard.

To derive a final reduction target, 48 violations from 1979 through 1981, were initially selected for analysis. These maximum hourly ozone concentrations exceeded

0.15 ppm. Of these, 31 violations were studied--days in which the high readings were downwind of Philadelphia, as prescribed by EKMA procedures. The final "design day" was then selected. It is shown in Table 3 with the pertinent atmospheric and meteorological conditions.

Table 3

Data Used in Applying the EKMA Model

Site selected		Trenton, New Jersey
Date		June 24, 1980
Observed Maximum Ozone		0.171 parts per million
Calculated Maximum Ozone		0.185 parts per million
Precursors	Ozone, surface	0.009 parts per million
	Ozone, aloft	0.050 parts per million
	HC, aloft, 1980	0.040 parts per million
	HC, aloft, 1987	0.024 parts per million
	HC/NO_x ratio	8.2:1
Mixing Height	Minimum, 8 a.m.	250 meters
	Maximum, 4 p.m.	1235 meters

EKMA estimates that a 44% reduction in VOC emissions from 1980 levels is required to attain standards by December 31, 1987.

Emission Inventory: The 1982 SIP contains inventories of VOC and NO_x that represent emissions for a typical summer weekday. The motor vehicle emissions were calculated by DVRPC. Point source emissions for Philadelphia County were calculated by the Philadelphia Air Management Services. The remaining emissions were calculated by the Department. Table 4 summarizes the origin of VOC emissions in southeastern Pennsylvania in the 1980 base year. Also shown is the projected emissions for 1987. A reduction in VOC emissions of 38.5% is estimated by 1987 as a result of the current emission control programs. Table 5 summarizes, in a similar manner, data for NO_x emissions. The reduction of NO_x emissions by 1987 is estimated to be 10.7%.

TABLE 4

SUMMARY TABLE OF REACTIVE VOC EMISSIONS*
FOR THE FIVE COUNTY SOUTHEASTERN PENNSYLVANIA REGION

	Base Year 1980		Baseline Projection 1987	
	Point	Area	Point	Area
STORAGE, TRANSPORTATION AND MARKETING OF VOC				
Oil and Gas Production & Processing				
Gasoline and Crude Oil Storage[1]	13,159		8,863	
Synthetic Organic Chemical Storage & Transfer				
Ship and Barge Transfer of VOC	5,822		5,822	
Barge and Tanker Ballasting	6,247		6,247	
Bulk Gasoline Terminals	210		210	
Gasoline Bulk Plants[3]	577		577	
Service Station Loading (Stage I)		10,218		305
Service Station Unloading (Stage II)		12,694		9,134
INDUSTRIAL PROCESSES				
Petroleum Refineries	45,864		29,469	
Organic Chemical Manufacture	4,709		2,582	
Inorganic Chemical Manufacture	5,004		5,004	
Pharmaceutical Manufacture	248		248	
Plastic Products Manufacture	51		51	
Rubber Tire Manufacture	2,721		952	
Textile Polymers & Resin Manufacture				
Synthetic Fiber Manufacture				
Iron and Steel Manufacture	5,537		2,248	
Others	7,258		6,009	
INDUSTRIAL SURFACE COATING				
Large Appliances	937		256	
Magnet Wire				
Automobiles	249		90	
Cans	6,682		1,834	
Metal Coils	1,619		1,415	
Paper	41,487		18,803	
Fabric	768		325	
Miscellaneous Metal Products	2,508		2,023	
Plastic Parts Painting	2,049		2,049	
Large Ships	387		194	
Large Aircraft	45		45	
Others	1,396		1,396	

*Kilograms per day (kg/day) for a typical summer weekday

	Base Year 1980		Baseline Projection 1987	
	Point	Area	Point	Area
NON-INDUSTRIAL SURFACE COATING				
Architectural Coatings		20,969		20,918
Auto Refinishing	125	12,172	125	12,537
Others	218		218	
OTHER SOLVENT USE				
Degreasing	1,482	13,676	1,087	10,232
Dry Cleaning	145	6,849	145	6,863
Graphic Arts	18,435	3,646	11,466	3,637
Cutback Asphalt		2,802		2,656
Consumer/Commercial Solvent Use		28,722		28,649
Adhesives	26		26	
Other	483		483	
OTHER MISCELLANEOUS SOURCES				
Fuel Combustion	2,857		2,853	
Solid Waste Disposal	776		776	
Forest, Agricultural, and Other Open Burning		1,706		1,713
Stationary Internal Combustion Engines				
MOBILE SOURCES				
Highway Vehicles		176,194		68,295
Off-highway Vehicles		12,849		12,792
Rail		6,254		6,275
Aircraft		5,396		4,784
Vessels		1,943		1,792
POINT SOURCE GROWTH			640	
Banked Emissions	410		410	
TOTAL	180,491	316,090	114,941	190,582
GRAND TOTAL	496,581		305,523	

[1]Includes all storage facilities except those at service stations and bulk plants.

[2]Emissions from loading tank trucks and rail cars.

[3]Emissions from storage and transfer operations.

$$\frac{496,581 - 305,523}{496,581} \times 100 = 38.47$$

TABLE 5

SUMMARY TABLE FOR OXIDES OF NITROGEN EMISSIONS*
FOR THE FIVE COUNTY SOUTHEASTERN PENNSYLVANIA REGION

	Base Year 1980		Baseline Projection 1987	
	Point	Area	Point	Area
EXTERNAL FUEL COMBUSTION				
Utility Boilers	55,689		55,689	
Industrial Boilers	3,586		3,586	
Commercial, Institutional, Residential	1,698		1,698	
STATIONARY INTERNAL COMBUSTION				
Reciprocating Engines				
Gas Turbines				
INDUSTRIAL PROCESSES				
Chemical Manufacturing				
Other	716		716	
Iron and Steel	10,372		10,372	
Mineral Products				
Cement				
Glass	833		833	
Other	6,035		6,035	
Petroleum Refining	24,931		24,931	
Other	6,760		6,507	
INCINERATION AND OPEN BURNING		469		468
MOBILE SOURCES				
Highway Vehicles		191,864		144,406
Off-highway Vehicles		11,248		11,931
Rail		23,551		24,702
Aircraft		3,700		4,033
Vessels		4,212		4,276
PHILADELPHIA COUNTY POINT SOURCES	60,610		60,610	
POINT SOURCE GROWTH			1,615	
TOTAL	171,230	235,044	172,845	189,816
GRAND TOTAL	406,274		362,661	

*Kilograms per day (kg/day) for a typical summer weekday

Current Emission Reductions: The emission inventories show decreases resulting from implementation of emission control programs currently authorized. These programs include:

1. Federal motor vehicle control program (FMVCP): This program regulates the amount of pollutants that may be emitted from new cars and trucks. In each successive model year, cars and trucks must meet increasingly more stringent emission standards. The VOC emissions from new vehicles will be reduced over 90%. As older vehicles wear out and as new vehicles are bought, the average emissions of the motor vehicle fleet will decrease. The FMVCP will be responsible for the most significant reduction in emissions of VOC in all metropolitan areas.

2. Inspection and maintenance of motor vehicles: The EPA memo, "Criteria for Approval of 1979 SIP Revisions" requires the implementation of an inspection and maintenance (I/M) program in all metropolitan areas with a population (1970) greater than 200,000. This program consists of inspection of all vehicles less than 10,000 pounds (gross vehicle weight) to determine whether the emission level of each vehicle meets established emission standards. These standards will be based on the calendar year of the vehicle. If the emission level exceeds the standard, the vehicle would have to be repaired in order to meet the standard and must be reinspected to assure compliance. By 1987, a minimum of 25% reduction in carbon monoxide and volatile organic compound tailpipe emissions will be required over and above the reductions which can be achieved through the FMVCP. The Commonwealth has committed to implement this program by June 1, 1984 according to the following schedule.

I/M Implementation Schedule

OBJECTIVE	DATE
Prepare analyzer	June 1, 1983
Prepare other needed regulations	July 1, 1983
Adopt analyzer regulations	August 1, 1983
Adopt other needed regulations	November 1, 1983
Award contract for sticker production	December 1, 1983
Develop public information activities	January 1, 1984
Begin public information plan	January 1, 1984
Have certified 2000 mechanics statewide	January 1, 1984

Develop plan for consumer protection	February 1, 1984
Have certified 2500 mechanics statewide	April 1, 1984
Have certified 3000 mechanics statewide	June 1, 1984
Fully implement I/M program	June 1, 1984

3. Regulation for stationary sources: These regulations impose reasonably available control technology on major sources of VOC. Regulations for sixteen sources of VOC were adopted in 1979. Regulations for eight other industrial sources were adopted in 1981.

4. Transportation control measures: Transportation control measures were developed by DVRPC. DVRPC identified fifteen control measures that could reduce emissions from motor vehicles. These measures and estimated VOC emission reduction in 1987 are:

Project Number	Project Title	1987 Emission Reduction (Kg/D)
PA 3-1	New Rapid Transit Vehicles	176
PA 3-2	New Light Rail Vehicles	9
PA 3-3	New Buses	107
PA 3-4	R.T. and L.R. Station Improvements	27
PA 3-5	Regionwide Shelters and Signs	7
PA 3-6	Transit Safety and Security	80
PA 3-9	Rt. 66 Trolley Line Extension	8
PA 3-10	Newtown C.R. Line Electrification	31
PA 4-1	Regional Ridesharing Program	257
PA 6-1	Airport H.S. Line	44
PA 6-2	Center City Comm. Conn.	159
PA 7-1	Center City Parking Policies	6
PA 11-1	Preferred Bicycle Route Map	32
PA 11-2	Other Bicycle Measures	-
PA 19-1	Educational Campaign	167
	Total	1110 Kg/D

Further Emission Reduction Measures: As discussed above, the region is required to reduce VOC emissions by 44% in order to achieve the ozone standard. The emission inventories show that a 38.5% emission reduction would be achieved. Thus, there is a "shortfall" of 5.5 percentage points or 27,438 Kg/D of emissions. The Department is examining several potential new emission reduction measures as follows:

Regulatory Measures	1987 Emission Reduction Potential (Kg/D)
Round III CTG	2,758
Stage II vapor recovery	7,764
Barge loading/unloading	4,949
Barge and tanker ballasting	3,124
Eliminate banked emissions	410
Architectural coatings	5,218
Anti-tampering	Unknown
Accounting Measures	
Transportation control measures	1,110
Shutdown sources	410
Previous offset transactions	258
Projected offset transactions	100
Changes in population projections	2,254
Total	28,355

A combination of these measures could be used to make up the shortfall. Any new regulations that may be needed will be developed according to this schedule:

Milestone	Completion Date
Complete collection of technical data	11/31/83
Submit draft regulation to A/W QTAC	2/31/84
Revise draft regulation and submit to EQB	6/15/84
EQB meeting	7/15/84
Public hearing	9/15/84
Submit final regulatin to EQB	12/15/84
Publish final regulation in Pa. Bulletin	3/15/85

The Environmental Protection Agency has developed control technology guidelines (CTG) to help assist states develop control requirements for major VOC sources. EPA has issued two sets of CTGs. EPA is in the process of developing a third set of CTGs. The Department will develop regulations for the third set of CTG documents on a schedule that is different from the above. This is consistent with the EPA policy of not requiring adoption of these regulations until after publication of the CTG by EPA. A preliminary review of the draft CTGs indicates that five companies may be potentially impacted. These companies are Rohm & Haas; NVF Co.: Talone A, Inc.; Witco Chemical Co.; and ICI Americas, Inc. The Commonwealth commits to adopt the Round III CTG controls based on the following schedule:

Milestone	Months After Promulgation
Complete collection of technical data	3
Submit draft reg. to A/WQTAC	6
Revise draft regulation and submit to EQB	9
EQB Meeting	10
Public hearing	14
Submit final regulation to EQB	17
Publish final regulation in Pa. Bulletin	20

All regulations developed by the Department are processed through a complex regulatory review before being implemented. All Department proposed regulations must be reviewed and approved by the Governor's Office of General Counsel, the Governor's Task Force on Regulatory Relief, the Independent Regulatory Review Commission, the Pennsylvania Legislature, the Attorney General, and the Environmental Quality Board. This review occurs at both the draft and final stages of the regulation development process.

Refinement of Ozone Modeling: There has been, in the Philadelphia area, a considerable amount of controversy regarding the accuracy of the EKMA model which was used in the 1982 SIP revision. A meeting was held in Essington, PA., on March 22, 1983 to discuss the model. At that meeting, Pennsylvania and New Jersey expressed some willingness to consider a reanalysis of the ozone modeling work in the Philadelphia metropolitan area. The Department believes that there is, at this time, a need to refine the modeling which was performed for the 1982 ozone SIP, especially because of the extraordinary measures which may be needed. The Department is, therefore, funding a remodeling study and is establishing a committee to assist DER and provide advice.

Reasonable Further Progress: Reasonable Further Progress (RFP) as defined in Section 171 if the Clean Air Act means the annual incremental reductions in emissions of an air pollutant that the EPA Administrator judges sufficient to provide for attainment of the standard by December 31, 1987.

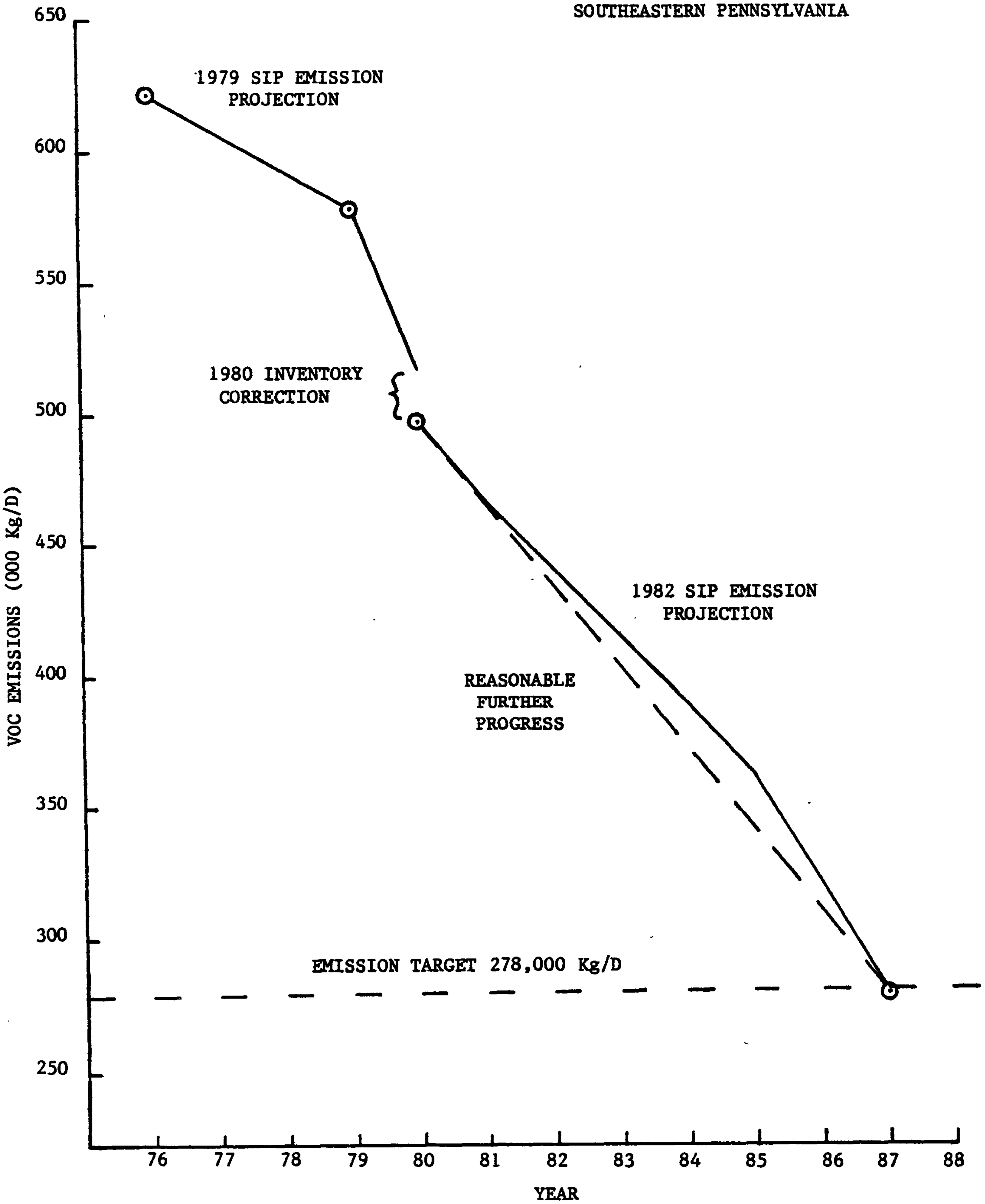
EPA requirements (46 FR 7187) indicate that RFP should be a straight line drawn from the base year to the projected attainment year. Figure 1 shows the RFP line for the Philadelphia region. Also shown is a plot of the projected VOC emissions. (The 1982 SIP inventory does not coincide with the 1979 SIP inventory because the methodologies used to develop the inventories differ.)

The figure demonstrates that the ozone standard will be achieved in the Philadelphia region provided that the further emission reduction requirements are implemented.

The Department will track progress in achieving the ozone standard through the annual NEDS reports currently submitted to EPA. The air quality monitoring system will be maintained in accordance with EPA siting criteria and quality assurance requirements. The three-year moving averages will be revised each year.

FIGURE 1

REASONABLE FURTHER PROGRESS
SOUTHEASTERN PENNSYLVANIA



CARBON MONOXIDE

Air Quality: EPA has established a National Ambient Air Quality Standard for carbon monoxide at 9 ppm averaged over an 8-hour period. The 1-hour standard is 35 ppm. Table 6 shows the latest air quality report for Philadelphia County ("APC Monitor", April 1983).

Table 6

Philadelphia Air Monitoring Data
March 1983

	Fed Air Qual Std		State & Local Air Monitoring Stations					
Carbon Monoxide, ppm	Prim	Sec	N LAB	N ASY	NPR	FRI	CHS	CSM
Arithmetic Avg. for month			1.1	1.8	2.2	1.3	1.7	2.1
Arithmetic Avg. last 12 mos.			1.3	2.3	2.9	1.2	1.9	2.3
Sec high 8hr. Avg. During Month			3.9	4.6	5.4	4.1	3.5	4.6
Sec high 8hr. Avg. Last 12 mos.	9	9	8.6	7.1	10.7	6.5	6.3	6.1
No. 8hr. Periods Over Std. Last 12 mos.	1	1	1	1	4	0	1	0
Sec high 1hr. Avg. During Month			8.0	7.0	10.0	7.0	5.1	7.0
Sec high 1hr. Avg. last 12 mos.	35	35	15.0	14.0	21.0	13.0	16.0	13.0
No. 1hr. periods over std. last 12 mos.	1	1	0	0	0	0	0	0

Table 6 shows no exceedances of the 1-hour standard and several of the 8-hour standard.

Emission Inventory: CO exceedances occur at conjested traffic corridors. Motor vehicles are the primary cause of the exceedances. DVRPC has estimated the motor vehicle emissions as shown in Table 7.

Table 7

Pennsylvania
Mobile Source (highway vehicle) Emissions Inventory

1980 Daily Operating Characteristics and Emissions in Kilograms by County

County	Average Speed in mph	VMT x 10^6	CO
Bucks	33.4	7.45	244,000
Chester	35.8	5.48	169,000
Delaware	27.7	6.56	253,000
Montgomery	30.1	10.94	394,000
Philadelphia	22.8	13.39	621,000
TOTAL	-	43.82	1,681,000

1987 Daily Operating Characteristics and Emimssions in Kilograms by County

County	Average Speed in mph	VMT x 10^6	CO
Bucks	33.8	8.19	114,000
Chester	36.2	5.71	75,000
Delaware	28.4	6.69	108,000
Montgomery	30.9	11.86	179,000
Philadelphia	23.5	14.42	277,000
TOTAL	-	46.87	753,000

These projections show the CO emissions decreasing by 55% by 1987.

Air Quality Modeling: Philadelphia AMS has performed an extensive modeling study to determine if the CO standard could be met by 1987. A copy of the study is attached to the SIP.

The study identifies eight intersections in the Philadelphia Central Business District where potential violations of the National Ambient Air Quality Standard for carbon monoxide are predicted for 1983. A plot of sidewalk concentrations predicts that only one intersection will remain in violation after 1983. The results of the study demonstrate that this single violation site, Broad & Vine, is projected to be eliminated prior to 1987 due to changes in the composition of the vehicle fleet and the greatly improved emission characteristics of that 1987 vehicle mix.

Based on the results of this study, Air Management Services established a continuous carbon monoxide monitor at the identified worst site, Broad & Vine Streets, in late January 1982. The limited data gathered indicates that this site has the highest CO levels of any being measured in the City. Air quality data from this site and others in the City is available for further study.

DELAWARE VALLEY TRANSPORTATION AIR QUALITY PLAN

1982

DELAWARE VALLEY
REGIONAL PLANNING COMMISSION

DELAWARE VALLEY

TRANSPORTATION-AIR QUALITY PLAN

(Portions of the 1982 Revisions to the
State Implementation Plans of
Pennsylvania and New Jersey)

This plan was funded by a grant from the Environmental Protection Agency with funds authorized by the Clean Air Act Amendments of 1977, Section 175.

DELAWARE VALLEY REGIONAL PLANNING COMMISSION

JUNE, 1982

No. B-82-005

RESOLUTION: ADOPTION OF TRANSPORTATION AIR QUALITY PLAN

WHEREAS, the Clean Air Act of 1977 requires each state to maintain an implementation plan describing the manner in which national ambient air quality standards will be achieved; and,

WHEREAS, New Jersey and Pennsylvania have designated the Delaware Valley Regional Planning Commission as the lead agency to prepare the transportation elements of the 1982 revisions to their respective state implementation plans; and,

WHEREAS, a draft document entitled "Delaware Valley Transportation Air Quality Plan" has been prepared in accordance with an approved work program; and,

WHEREAS, the planning was accomplished in consultation with affected interests and the general public as required by the Act and EPA guidance; and,

WHEREAS, public hearings were held on March 30th and April 15th, 1982, and consideration has been given to public commentary and testimony received before the hearing record closed April 26th;

NOW, THEREFORE, BE IT RESOLVED, that the plan summarized in Attachment 1, amended to include the changes in Attachment 2, is adopted as a part of the region's transportation plan and that a copy of the adopted "Delaware Valley Transportation Air Quality Plan" document be transmitted to the states for inclusion in their state implementation plans, recognizing that implementation of the plan is dependent upon the availability of funding (for technical studies, capital improvements and operations) and that there are other legitimate social and economic concerns which may influence the completion of projects;

BE IT FURTHER RESOLVED, DVRPC is committed to bringing its long- and short-range plans into conformity with the 1982 revisions to the Pennsylvania and New Jersey state implementation plans; and

BE IT FURTHER RESOLVED, DVRPC will continue, as required, to produce an annual report on transportation-air quality planning; and

BE IT FURTHER RESOLVED, that in the event the annual report indicates a lack of reasonable further progress, DVRPC is committed to seeking the implementation of additional or substitute projects.

Adopted by the Board of the Delaware Valley Regional Planning Commission this 27th day of May, 1982

DELAWARE VALLEY DRAFT TRANSPORTATION-AIR QUALITY PLAN
PUBLICATION INFORMATION

DVRPC Control Number	82-001
Report date	June, 1982
Action taken	TAC: Approved May 1982 PCC: Approved May 1982 Board: Approved May 1982
Work program reference	43.066.20 (Incorporates material from all 43 series projects)
Subject matter	Air quality Transportation
Availability	DVRPC Public Affairs Office
Abstract	The Plan provides portions of the transportation elements for the State Implementation Plans for Air Quality for Pennsylvania and New Jersey. Recommendations are made for the region to pursue certain programs in order to reduce the amount of automobile travel in the region to help attain national air quality standards for ozone and carbon monoxide. Measures discussed herein (but not necessarily recommended) include: new public transit services, improvements in transit reliability, promotion of transit through public information and new fare strategies, improvements in security and maintenance of vehicles and stations, parking controls, reserved lanes for high occupancy vehicles, park-and-ride facilities, educational programs, bicycle facilities, and ridesharing programs. Other subjects discussed are growth assumptions for the region, an emissions inventory and establishment of a reduction target; an exposition of methodology and description of public participation; and a discussion of the transportation planning process and how it will be adapted to address air quality objectives.
Key words	State Implementation Plan Transportation Control Program Section 175, Clean Air Act
Distribution Statement	To be sent to DVRPC mailing list for Transportation TAC, Planning Coordinating Committee, and DVRPC Board. Also will be sent to others on request in response to notices published in AIR MAIL and in publications of the Clean Air Council, League of Women Voters and Keystone Motor Club.
Number of pages	About 175

DELAWARE VALLEY
TRANSPORTATION-AIR QUALITY PLAN

(Portions of the 1982 Revisions to the State Implementation Plans of Pennsylvania and New Jersey)

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SUMMARY

The Delaware Valley Transportation-Air Quality Plan responds to the mandate of the 1977 Amendments to the Clean Air Act. Congress instructed that special efforts be made to reduce emissions of transportation-related pollutants where standards for these substances were still being violated after 1979. The Delaware Valley Regional Planning Commission is the agency responsible to develop such a plan in the nine-county Metropolitan Philadelphia-Trenton area. The plan will become a part of Pennsylvania's and New Jersey's "State Implementation Plans" to achieve national ambient air quality standards.

The pollutant toward which this plan is primarily directed is ozone, a major constituent of smog, and an irritant affecting the eyes and respiratory systems. Ozone can be especially unhealthful to the young, the old and those affected by respiratory ailments. It is also damaging to vegetation and to materials such as paint and rubber. The goal of the Clean Air Act is to reduce the maximum hourly ozone concentrations to less than 120 parts per billion for all urbanized areas as soon as practical, but no later than 1987.

Ozone is formed in the atmosphere from two "precursor" substances — hydrocarbons and oxides of nitrogen. The accepted approach to reduce ozone is to reduce the emissions of hydrocarbons into the atmosphere. In 1980, about 750,000 kilograms (kg) of reactive hydrocarbons were emitted each day, resulting in three to thirty days of violations each year depending upon weather conditions. Ozone violations occur during the summer, when heat and sunlight, which are necessary for its formation, are greatest.

Using a prescribed EPA Model, DVRPC calculates that a reduction of hydrocarbon emissions to about 412,000 kg/day is necessary to achieve the standard. About 455,000 kg/day are projected to be emitted in 1987, apparently leaving the region 43,000 kg/day short of the level it requires. There is, however, great uncertainty about the accuracy of the calculated emission reduction target. The reduction between 1980 and 1987 is attributable to presently programmed control methods, including those on industry, the design and manufacture of motor vehicles and an inspection and maintenance program for Pennsylvania. Motor vehicles will reduce its share from about one-third of hydrocarbon emissions in 1980 to about 20% in 1987.

This plan recommends ways in which emissions from motor vehicles can be further reduced. However, application of "reasonably available control measures" will only decrease emissions by less than 1,600 kg/day. Yet, inasmuch as motor vehicles will only contribute one-fifth of the emissions in 1987, this is not an insignificant contribution.

The two-year study, which resulted in thirty-five recommended projects, examined over one hundred strategies. A preliminary analysis rejected a number of measures and focussed the study on those determined to be most promising, both in terms of their effectiveness and the likelihood that they could be initiated before 1987. The detailed studies which followed carefully calculated the emission reductions associated with each measure and the most expeditious schedule for each project or program. The recommendations contained in the draft plan were made by DVRPC staff. Following deliberation by the public, other transportation advisers to DVRPC and local elected officials, the DVRPC Board adopted a plan which differed slightly from the draft.

Improved attractiveness of facilities includes several diverse projects: (1) improved station improvements, such as better lighting, improved security, and installation of vandal-proof materials, in Philadelphia, (2) shelters and improved signs at many SEPTA bus stops, (3) television surveillance at Philadelphia rapid transit and light rail stations, (4) projects to increase on-time performance of New Jersey Transit buses, and (5) installation of two-way radios in buses in New Jersey, thereby improving security and reliability. In New Jersey, rationalization of fares will encourage ridership from patrons who have been confused by the present complex fare structure.

The plan calls for continued monitoring of the success of each measure. Those which prove ineffective may be dropped. If future calculations demonstrate that planned reductions in emissions are not occurring, the plan calls for a revision and restoration of the trend toward attainment.

Public participation in the formation and commitment to this plan has been actively solicited. Opportunities were provided for interested persons to learn more about the plan and the supporting studies and to respond with favor or objection to the DVRPC

1 THE GOAL OF CLEAN AIR

1.1 INTRODUCTION

Motor vehicles, including private automobiles, contribute significantly to air pollution in the Philadelphia region. In 1980, 33% of the ozone problem was attributable to mobile sources. Also, nearly 90% of the carbon monoxide and nearly 50% of the oxides of nitrogen were emitted by mobile sources in that year. The region currently violates standards occasionally for ozone, and infrequently violates standards for carbon monoxide; there have been no violations of the nitrogen dioxide standard in recent years. Mobile sources also contribute to the levels of other pollutants for which standards have been set, notably lead and particulates. These pollutants will be addressed in other parts of the State Implementation Plans.

The Clean Air Act Amendments of 1970 requires each state to develop and maintain "State Implementation Plans," or SIPs, as they are commonly known. SIPs describe regulations and guidance adopted by the state to reduce emissions and to achieve national ambient air quality standards by a target date. Good progress has been made in reducing emissions in recent years through implementation of the SIPs as well as federal requirements for emission controls to motor vehicles.

The Clean Air Act Amendments of 1977 provide for joint transportation and air quality planning in regions where standards for transportation-related pollutants had not been met by 1977. The amendments require planning agencies in these "non-attainment" areas to test certain transportation control measures for applicability in the region and to implement a sufficient number of them to achieve standards by 1987 at the latest. If a 1979 SIP revision can demonstrate attainment by 1982, a second revision is unnecessary. In the Philadelphia region, the 1979 revisions (for Pennsylvania and New Jersey — reference 28 and 29, respectively) show that the region will require an extension until 1987 for the ozone standard to be attained and a shorter extension for the carbon monoxide standard to be attained. Therefore, a second and more ambitious 1982 SIP revision is required. The plan which follows constitutes the region's response in regard to transportation measures.

The area for which this plan applies includes the five Pennsylvania counties of Bucks, Chester, Delaware, Montgomery and Philadelphia and the New Jersey counties of Burlington, Camden, Gloucester and Mercer. Policies and projects which apply only to one of the states are so indicated. Upon adoption by the DVRPC Board, this plan becames a part of the region's Transportation Plan and was forwarded to each state which will incorporate it (with revisions as they see fit) in their respective SIPs. Revisions for 1982 must by law be presented to EPA before July 1, 1982.

DVRPC has been designated by each of the states through memoranda of understanding (Reference 28, p. 1-2) as the responsible agency to prepare most transportation portions of the SIPs. The states retain the responsibility for developing and operating vehicle inspection and maintenance programs, vapor recovery devices for fueling operations and any requirements for retrofitting of emission control equipment. The states also are responsible for controls on stationary sources in the suburban counties, but Pennsylvania shares this responsibility with the city's

Department of Health (Air Management Services) in Philadelphia. Requirements placed on the design and manufacture of automobiles are the direct responsibility of EPA. DVRPC's role in limiting emissions from mobile sources is primarily aimed at reducing the amount of travel made by private automobiles.

The first section of the plan provides:

(a) a description of the present air quality problem;
(b) an explanation of how existing and programmed stationary and mobile source controls will affect the problem; and
(c) a statement of the total shortfall in emissions reduction and the target reductions required to bring the region into attainment.

Section 2 of this document presents the region's response to the problem in a plan for clean air. Following an explanation of the planning methods employed, the section presents information on a series of measures which have been selected by the DVRPC Board. There follows a discussion of how these measures, taken together, can help to attain air quality standards.

The last section of the report describes the activities which will advance the recommendations of the plan. In particular, recent and proposed modifications to the transportation planning process are discussed.

Four appendices are bound into the report. The first two of these describe reserved measures, from which future transportation controls may be derived in the event of a shortfall, and rejected measures, for which recent studies demonstrate are not practical or effective for this region. The third appendix is a list of references used in the plan. The last appendix includes reproductions of letters of commitment.

Supplements to the report include backup reports prepared by DVRPC staff, its member governments, or consulting firms. Interested persons may request copies of any of these by contacting DVRPC. Supplementary reports available for public distribution can be found in the list of references. These references are marked by an asterisk.

1.2 Air Quality Trends

During the 1970s there was a steady decline in hydrocarbon (HC), oxides of nitrogen (NOx) and carbon monoxide (CO) emissions in the Philadelphia Air Quality Control Region due to federal and state air quality control regulations. Large reductions were obtained through the Federal Motor Vehicle Control Program from mobile sources of emissions, and significant progress was made in controlling major stationary source emissions. Have these reductions resulted in cleaner air?

The ozone data gives an inconclusive picture of the trend of ozone violations in the region. Table 1.1 lists the number of exceedances of the ozone standard at selected monitoring sites in Pennsylvania and New Jersey. The trend since 1978 appears to be downward, except for 1980. The data for this year highlights the difficulty in interpreting yearly frequency data. Meteorological conditions were

TABLE 1.1

Number of Exceedances of Ozone Standard
at Selected Monitoring Sites

Monitor Site	1978	1979	1980	1981
New Jersey				
Somerville	4	4	2	3
Camden Laboratory	10	8	16	6
Trenton	4	4	16	7
Pennsylvania				
Bristol	11	8	20	4
Chester	16	9	26	6
Norristown	19	8	30	6
N.E. Philadelphia	13	6	14	4
Roxborough	3	7	8	3
S.E. Philadelphia	8	1	0	N.A.

TABLE 1.2

Ozone Design Value
at Selected Monitoring Sites
(parts per million)

Monitor Site	1978	1979	1980	1981
New Jersey				
Somerville	.220	.163	.138	.138
Camden Laboratory	.175	.161	.166	.166
Trenton	.175	.133	.165	.164
Pennsylvania				
Bristol	.215	.203	.196	.178
Chester	.215	.201	.180	.171
Norristown	.199	.196	.180	.178
N.E. Philadelphia*	.19	.19	.18	.17
Roxborough*	.17	.17	.16	.16
S.E. Philadelphia*	.20	.17	.17	N.A.

*Philadelphia maintains data only to two significant figures

NOTE: The federal air quality standard for ozone is .12 ppm for a one hour period.

particularly favorable of ozone formation in 1980. Table 1.2, however, shows that even in these conditions, the design value, reflecting the trend of the anticipated second highest reading and using data from three year periods, continued to decline steadily between 1978 and 1981.

Carbon monoxide dissipates rapidly and is therefore likely to exceed standards only in locations with sustained high traffic volumes. The CO monitoring sites best located to meet these conditions are in Philadelphia and several New Jersey cities. Table 1.3 shows the number of violations at some monitoring sites between 1977 and 1981. Figure 1.1 illustrates the trends for second-highest CO levels. Both show a clearly downward trend. The Pennsylvania SIP estimates that there will be no CO violations in Philadelphia after 1983.

In summary, the data show that there has been steady improvement in the region's air quality. The improvement is more dramatic for carbon monoxide than for ozone, even though, as shown in the next section, HC emissions have been decreasing as fast as for CO. This situation is probably due to the nature of ozone formation where the relationship among ozone and its precursors, primarily HC and NOx, is thought to be non-linear. Thus, for example, a 50 percent emission reduction may result in only an 35 percent decrease in ozone levels.

1.3 Emission Reduction Trends

The Clean Air Act requires that HC, NOx and CO emissions be reduced at a rate which will ensure that the ozone and carbon monoxide standards are met as expeditiously as possible, but before 1987. In this section the emission reduction already achieved through control on stationary and mobile sources will be discussed.

1.3.1 Point and area source emission trends

The Environmental Protection Agency has issued two of three sets of control technology guidelines, each set covering certain industrial groups. Both Pennsylvania and New Jersey have issued regulations based on these guidelines. Industrial emissions are affected by the regional and national (to the extent they participate in it) economic climate. The growth in jobs and business investment in the Delaware Valley was slow during the 1970s, with most growth taking place in service industries. This situation assisted the reduction in point source emissions.

Other emissions come from diffuse sources, many of which are too small to control. These are commonly referred to as area sources. Typically these are emissions from households and small businesses, and since they are usually not regulated, their change is affected by the region's growth rate. During the 1970-1980 period, the region lost population. The Pennsylvania counties lost 5.8 percent of their population (206,966 persons) and New Jersey gained 6.4 percent (80,587 persons). However, insofar as area source emissions are a function of housing units and businesses rather than people, Pennsylvania experienced a 10.9 percent growth and New Jersey a 25.1 percent growth. (Housing units grew faster than the population because of the smaller family size.)

TABLE 1.3

Number of Carbon Monoxide
Exceedances at Selected Monitoring Sites

Monitor Site	1977	1978	1979	1980	1981*
New Jersey					
Camden Laboratory	20	4	19	0	0
Paulsboro	5	12	0	0	N.A.
Burlington City	94	35	42	5	0
Pennsylvania					
AMS Laboratory	0	0	0	0	0
N. Broad	26	5	15	1	0
Franklin Institute	4	2	0	0	0
S. Broad	4	6	0	0	0

*Through November 1981

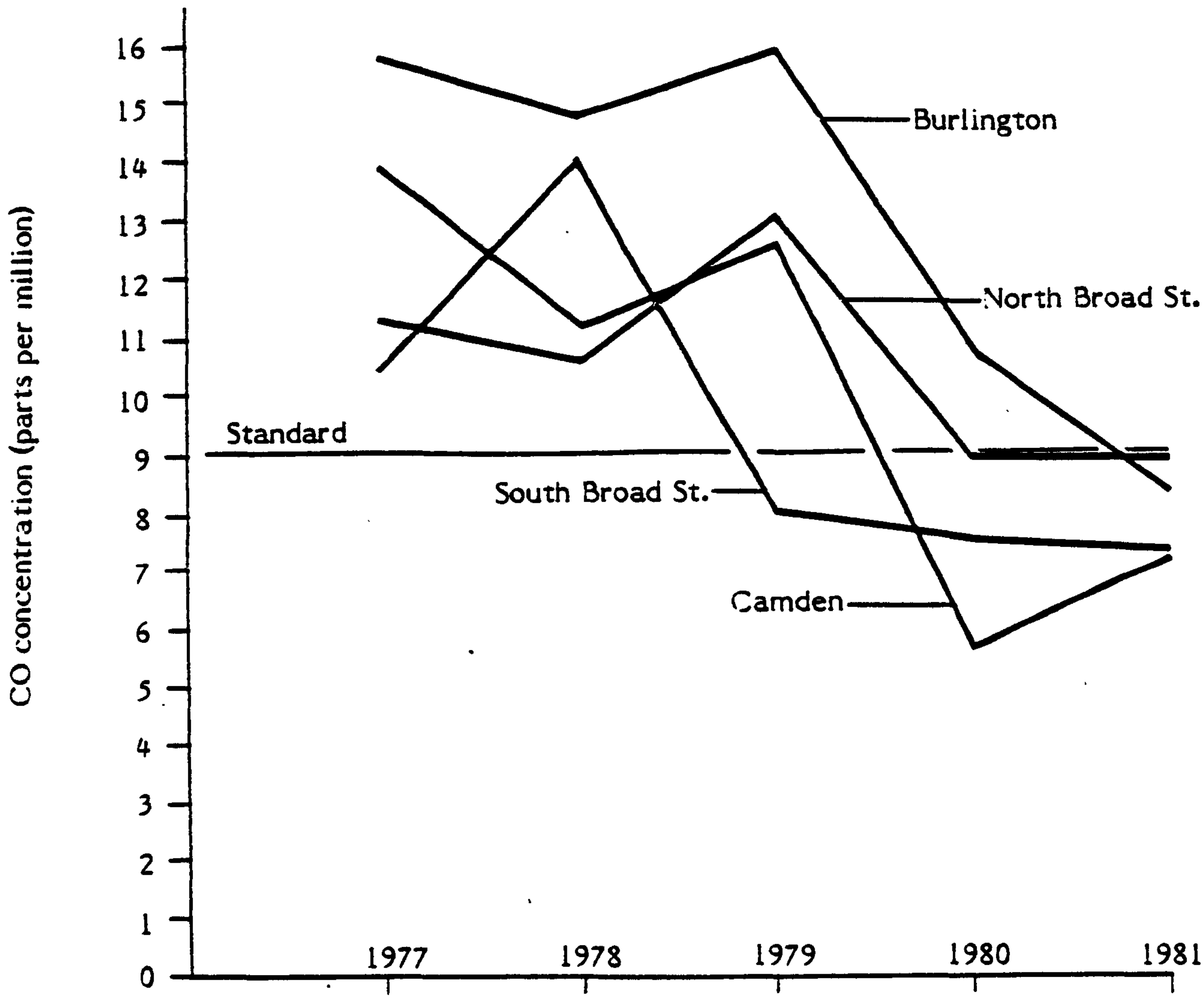

FIGURE 1.1
Second Highest 8-hour Average CO Concentrations

1.3.2 Mobile source emission trends

There are three general strategies used to reduce mobile source emissions. The first is the Federal Motor Vehicle Control Program (FMVPC) which uses on-vehicle control devices to reduce exhaust and evaporative emissions. This strategy has been highly effective and is responsible for most of the rapid decline in mobile emissions. The second is inspection and maintenance (I/M) programs which require periodic checks to ensure that the FMVPC devices are working properly. In this region, only New Jersey has had an I/M program in operation. I/M is fairly effective in reducing emissions. Finally, transportation management measures can be used to reduce emissions through modifying the behavior of the users of the transportation system. Such measures have not been as effective in reducing mobile source emissions to date.

1.4 Baseline Emission Forecasts

Estimates of emissions in 1980 and forecasts of emissions in 1987 have been prepared by several agencies. The term "baseline" as applied to these estimates for 1987 refers to the case in which only present policies are implemented. The major assumptions employed in developing the baseline are:

1. Point sources will be regulated to the degree recommended by EPA's Control Technology Guidelines, as agreed to by both states in their State Implementation Plans.

2. The region's growth rate will be consistent with DVRPC's Regional Development Guide (RDG). Population by county is interpolated between the 1980 and Year 2000 RDG targets in Pennsylvania and in New Jersey the water quality management plan (208) numbers, which are higher, are assumed. See Table 1.4.

3. Pennsylvania will establish an I/M program for the urbanized portion of Southeastern Pennsylvania.

4. Mobile source emission reduction will continue to be achieved from the FMVPC program (as calculated using EPA's MOBILE 2 program).

5. A number of expressway improvements will be constructed before 1987, as listed below:

Facility	From	To	Lanes
Woodhaven Road	Roosevelt Blvd.	Philmont Avenue	4
Pottstown Expressway	U.S. 422	Egypt Road	4
Vine Street (I-676)	Sixteenth Street	Benjamin Franklin	4
Mid-County (I-476)	Interstate 95	MacDade Blvd.	4
Newtown Bypass	PA 413	Interstate 95	4
Delaware Exp. (I-95)	Industrial Highway	Girard Point Bridge	8
New Jersey 55	U.S. 40	New Jersey 42	4
Interstate 295	Crosswicks Creek	Kuser Avenue	6
Interstate 195	Interstate 295	Broad Street	4
U.S. 322	U.S. 130	Interstate 295	4
New Jersey 90	U.S. 130	New Jersey 73	4
Pennsylvania Turnpike	Plymouth Meeting	Delaware River	6*
Interstate 295	Delaware Street	Repaupo Road	6*

*Widen Existing Facility

TABLE 1.4

1980 and 1987 Population by County

PENNSYLVANIA

County	1980 Census*	1987 Estimate**
Bucks	479,000	512,000
Chester	317,000	323,000
Delaware	555,000	540,000
Montgomery	644,000	667,000
Philadelphia	1,688,000	1,641,000
TOTAL	3,683,000	3,683,000

* Bureau of the Census, Advance Reports, PHC80-V-40, issued March 1981, nearest thousand.

**From a smooth curve drawn tangent to the straight line through the 1970 and 1980 Census at 1980 and with yearly changes accelerating toward 2000 and passing through the Regional Development Guide target population for 2000.

NEW JERSEY

County	1980 Census*	1987 Estimate**
Burlington	379,000	408,000
Camden	527,000	563,000
Gloucester	217,000	238,000
Mercer	349,000	371,000
TOTAL	1,472,000	1,580,000

* New Jersey Department of Environmental Protection, New Jersey Water Quality Management Plan, March 1979

**Straight line interpolation between 1980 and 2000 estimates in document cited above.

The results of DVRPC's Mobile Source Emission Inventory by county for Pennsylvania are presented in Table 1.5 and for New Jersey in Table 1.6.

The baseline forecasts do not include potential benefits from recommended transportation control measures contained in this document, or additional point source controls that the states may include in the 1982 SIP revisions.

Table 1.7 shows the changes in all sources of emissions for VOC, NOx and CO for the period 1980-1987. Hydrocarbon emissions decline by 36 percent over the period, with Pennsylvania experiencing a larger decrease, 38 percent, than New Jersey, 32 percent. By source category, mobile sources show the largest decline in Pennsylvania, 64 percent, and a 52 percent decrease in New Jersey. The faster decline in Pennsylvania is due to the start of the I/M program, which New Jersey has had in operation for some years. In 1980 mobile source HC emissions were 33 percent of total HC emissions, and in 1987, they are expected to be only 20 percent.

NOx emissions show a much slower rate of decline, and will be eight percent lower in 1987. The decrease will be greater in Pennsylvania than New Jersey, and mobile sources in both states will account for all of the decline. Carbon monoxide, which is largely a mobile source pollutant is estimated to decline 48 percent over the period. The decline will be most rapid in Pennsylvnia due to the start of the I/M program.

1.5 Emission Reduction Target

In February, 1982, DVRPC calculated the percent reduction in volatile organic compounds (VOC) emissions from 1980 required to attain the national ambient air quality standard for ozone by 1987. The calculation was based upon the emissions inventory for 1980 presented in Section 1.4 and was made using EPA's "Empirical Kinetic Modelling Approach" or EKMA.

EKMA estimates the percent reduction of VOC based upon conditions specific to the Philadelphia region. The model relates the maximum hourly ozone concentration recorded at a site downwind of the central business district (CBD) of a column of air originating at the CBD at 8 a.m. and migrating to the monitoring site. The column begins its journey with a fixed concentration of ozone and ozone precursors (VOC and oxides of nitrogen) stretching from the surface to the nighttime inversion layer. This column is then augmented by local emissions as it moves toward the suburban monitor while it expands with lifting of the inversion lid. The precursors undergo a complex series of chemical reaction throughout the day which produce ozone.

In deriving a final reduction target, 48 site-days from 1979 through 1981, where the maximum hourly ozone concentrations exceeded 0.15 parts per million, were initially selected for analysis. Of these, 31 site-days were studied — days in which the high readings were downwind of Philadelphia, as prescribed by EKMA procedures. The final "design day" was then selected which is shown in Table 1.8 with the pertinent atmospheric and meteorological conditions.

TABLE 1.5

PENNSYLVANIA
MOBILE SOURCE (HIGHWAY VEHICLE) EMISSIONS INVENTORY

1980 Daily Operating Characteristics and Emissions in Kilograms by County

County	Speed in mph	VMT x 10^6	CO	NMHC	NOx
Bucks	33.4	7.45	244,000	26,900	33,900
Chester	35.8	5.48	169,000	19,000	25,600
Delaware	27.7	6.56	253,000	26,600	27,800
Montgomery	30.1	10.94	394,000	42,100	48,400
Philadelphia	22.8	13.39	621,000	61,600	56,200
TOTAL	-	43.82	1,681,000	176,200	191,900

1987 Daily Operating Characteristics and Emissions in Kilograms by County

County	Speed in mph	VMT x 10^6	CO	NMHC	NOx
Bucks	33.8	8.19	114,000	9,900	26,000
Chester	36.2	5.71	75,000	6,600	18,800
Delaware	28.4	6.69	108,000	9,200	20,000
Montgomery	30.9	11.86	179,000	15,400	37,100
Philadelphia	23.5	14.42	277,000	22,800	42,500
TOTAL	-	46.87	753,000	63,900	144,400

Prepared by DVRPC staff, December, 1981. Based upon EPA MOBILE 2 factors, Inspection/Maintenance program effective in 1987 in urbanized portion of region, and 1987 population interpolated between 1980 census and Year 2000 Regional Development Guide target.

TABLE 1.6

NEW JERSEY
MOBILE SOURCE (HIGHWAY VEHICLE) EMISSIONS INVENTORY

1980 Daily Operating Characteristics and Emissions in Kilograms by County

County	Speed in mph	VMT x 10^6	CO	NMHC	NOx
Burlington	35.0	7.08	172,000	20,600	33,300
Camden	30.3	7.16	197,000	22,500	32,100
Gloucester	38.8	3.75	84,000	10,400	18,400
Mercer	30.5	4.68	128,000	14,700	21,400
TOTAL	-	22.67	581,000	68,200	105,200

1987 Daily Operating Characteristics and Emissions in Kilograms by County

County	Speed in mph	VMT x 10^6	CO	NMHC	NOx
Burlington	34.5	8.10	108,000	9,400	26,600
Camden	30.7	8.56	126,000	10,800	27,100
Gloucester	36.7	4.75	61,000	5,300	16,200
Mercer	31.0	5.91	87,000	7,400	19,100
TOTAL	-	27.32	382,000	32,900	89,000

Prepared by DVRPC staff, December, 1981. Based upon EPA MOBILE 2 factors, Inspections and Maintenance effective in 1980 and 1987, and 1987 population based upon Section 208 Water Quality projections developed in 1977.

TABLE 1.7

Baseline Emission for 1980 and Forecasts for 1987
(kilograms per day)

	1980			1987			Percent Change		
	VOC	NOx	CO	VOC	NOx	CO	VOC	NOx	CO
Pennsylvania*									
Point	185,620	171,230	N.A.	120,070	172,592	N.A.	-35	+ 1	-
Area	139,896	43,180	N.A.	122,287	45,410	N.A.	-13	+ 5	-
Mobile	176,194	191,864	1,681,331	63,890	144,406	753,061	-64	-25	-55
TOTAL	501,710	406,274	N.A.	306,247	362,408	N.A.	-39	-11	-
New Jersey**									
Point	69,217	81,938	4,344	32,476	92,371	4,344	-53	+13	0
Area	97,647	36,305	83,084	83,579	36,333	83,648	-14	0	+ 1
Mobile	68,164	105,182	580,960	32,873	88,923	382,441	-52	-15	-34
TOTAL	235,028	223,425	668,388	148,928	217,627	470,433	-37	- 3	-30
REGIONAL TOTAL	736,738	629,699	N.A.	455,175	580,035	N.A.	-38	- 8	-

*Note: Assumes, for 1987, I/M in urbanized portion of Southeastern Pennsylvania, and RDG forecasts.
**Note: Assumes, for 1987, water quality management plan (208) population forecasts.

TABLE 1.8
Data Used in Applying the EKMA Model

Site selected		Trenton, New Jersey
Date		June 24, 1980
Observed Maximum Ozone		0.171 parts per million
Calculated Maximum Ozone		0.185 parts per million
Precursors	Ozone, surface	0.009 parts per million
	Ozone, aloft	0.050 parts per million
	HC, aloft, 1980	0.040 parts per million
	HC, aloft, 1987	0.024 parts per million
	HC/NOx ratio	8.2:1
Mixing Height	Minimum, 8 a.m.	250 meters
	Maximum, 4 p.m.	1235 meters

EKMA demonstrates that a 44% reduction in VOC emissions from 1980 levels are required to attain standards by December 31, 1987. In Section 1.4, it was shown that VOC will be reduced by 38% without the implementation of any of the measures recommended in this plan. Therefore, a shortfall of 6% of the 1980 levels appears to exist. In absolute terms, emission reductions to the level of 412,600 kg/day are required for attainment, or about 42,600 kg/day less than the 455,200 kg/day projected to be emitted. Emission inventories for 1976, 1980 and 1987 are compared to the attainment level in Figure 1.2.

Caution should be used in accepting the emission reduction target described above. There are alternative assumptions regarding the 1987 emissions inventory which could either increase or decrease the shortfall. The following paragraphs describe some of these:

> An inspection and maintenance (I/M) program is assumed to be established only in the urbanized portion of the Pennsylvania counties, as the Pennsylvania Department of Environmental Resources is currently proposing. If I/M were applied throughout the region, an additional 2,100 kg/day would be eliminated.
>
> If New Jersey's baseline conditions were to employ DVRPC's Regional Development Guide (RDG) projections of population instead of those used for "208" water quality planning, for mobile sources only, the 1987 baseline emissions for New Jersey and the region would decrease by 3,800 kg/day. The change would be even greater if RDG projections were used for area source estimates also; perhaps the shortfall would be reduced by another 8,400 kg/day. On the other hand, New Jersey area source emission were based on a 1980 population greater than the Census, reducing the effect of increasing the emissions reduction requirement.

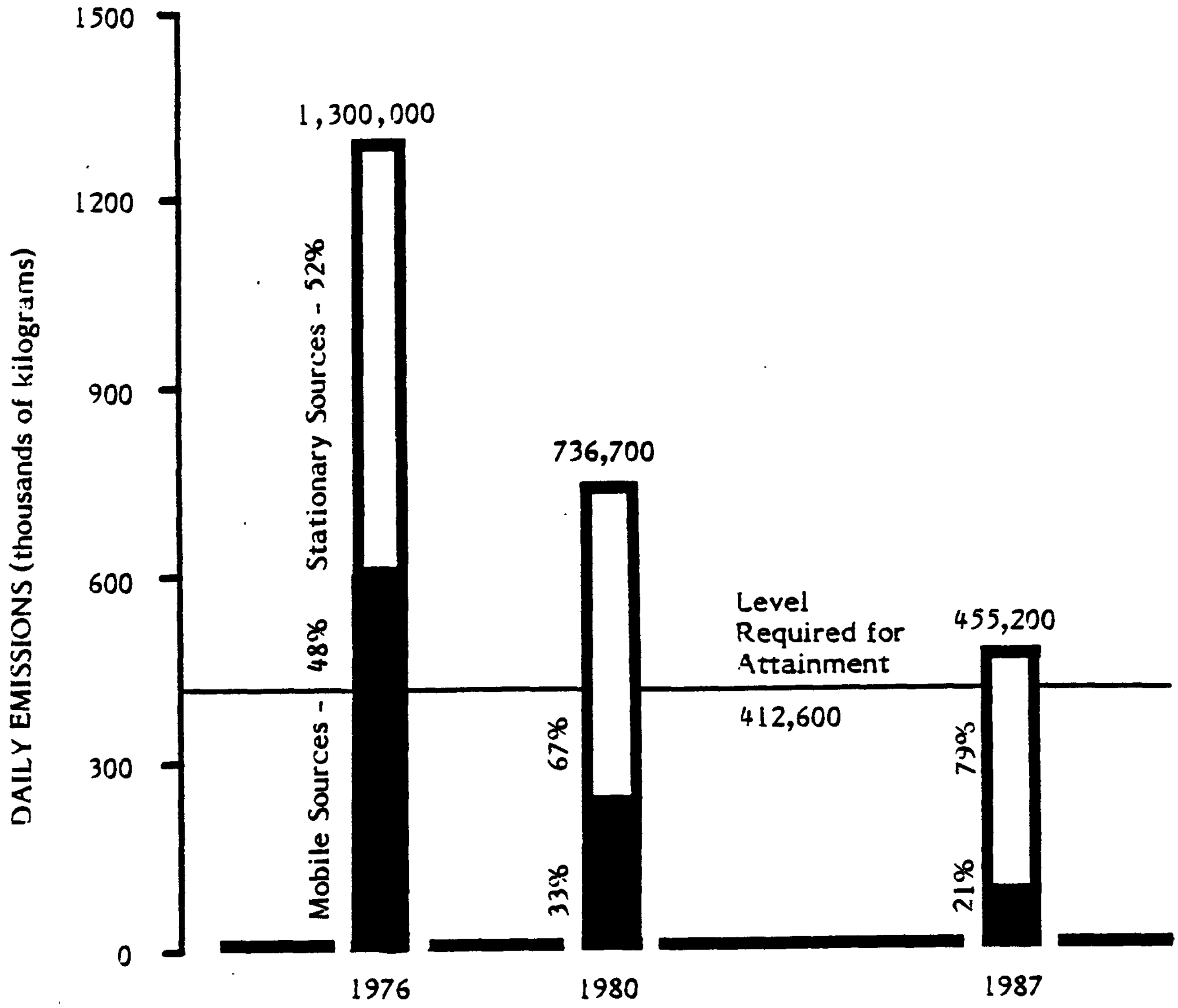

FIGURE 1.2

Total Reactive Hydrocarbon Emissions

In May, 1982 the Pennsylvania Department of Environmental Resources (DER) performed a sensitivity analysis of the EKMA model as it was applied in the Philadelphia region. All input parameters to the EKMA model were varied over a range of values which reflected the accuracy of their measurement. For instance, the HC/NO_x ratio was varied from 6.0:1 to 10.5:1 because this is the range of values measured for the Philadelphia area for days which show violations of the ozone standard. The Department has conducted this study in order to determine how the EKMA model varies when the model inputs are changed.

The Department used DVRPC's inputs for June 24, 1980. This was the day selected as the "control" data for the 1982 State Implementation Plan revisions. DER varied one input parameter at a time and analyzed the computer results for four potential $HC:NO_x$ ratios.

DER concluded that their results demonstrate that the EKMA model is highly variable and uncertain. In several cases cited in the study, the emission reduction requirements ranged from less than 35% to 38% even where the $HC:NO_x$ ratio was maintained at 8.2:1. Where the median ratio of 6.9:1 is used, and all other parameters are maintained as in the DVRPC run, the emission reduction requirement is slightly more than 37%.

In Section 2, vehicle controls are described which will further decrease the 1987 emissions levels. The effect of these controls, taken together is discussed in Section 2.5.

2 THE PLAN FOR CLEAN AIR

2.1 INTRODUCTION

The objective of the studies conducted by DVRPC and others during 1980 and 1981 was to determine which of many possible control measures are reasonably available to this region in reducing emissions of pollutants from mobile sources. The Clean Air Act requires that such "reasonably available control measures," or RACMs, be put into effect so that continuous progress is made between the present and 1987, by which time national ambient air quality standards (NAAQS) must be met.

The major portion of this section consists of descriptions of projects and programs which have been determined by planners of the region to be reasonably available. These measures can be characterized as those which appear to have a combination of effectiveness and public acceptability as to make them feasible. The procedures used to determine feasibility are described in 2.2.

The analysis of candidate measures was completed without the benefit of knowing how many measures would be needed to attain NAAQS. Several assumptions needed to be established before it could be known what sum of the emission reductions from adopted measures must be to attain NAAQS. Included among these are:

(a) the population of the region in 1987;

(b) the emission rates from motor vehicles of various types and under various driving conditions;

(c) the driving patterns and the highway and transit systems in 1987; and

(d) the reductions to be made by stationary source controls and by motor vehicle inspection and maintenance.

Also needed to be known was the recent actual air quality resulting from the present level of pollutant emissions. Not until January 1982 were all of these items quantified and a precise emission reduction target established. Therefore, the projects recommended include all reasonably available control measures, without regard to the number or extent needed to achieve standards.

The disposition of all measures ever considered by DVRPC is summarized in the list in 2.3. Each recommended measure is described in detail in 2.4. A demonstration how the combined measures will reduce emissions is made in 2.5 and this reduction is compared to the target described in 1.4.

2.2 METHODS

Each measure considered for inclusion in the Transportation Air-Quality Plan was examined on a technical basis to determine its impact on emissions, its costs and its other impacts (such as gasoline consumption), and changes in travel patterns. Also, each measure was discussed among those agencies and publics which will be affected by it. Together, these approaches led to selection of the most technically effective and politically feasible (i.e., reasonably available) measures.

The 1979 SIP revision from Pennsylvania contained a promise that DVRPC would study sixty-five measures. Additional measures were added to the analysis during the planning for the 1982 SIP revisions.

In all, about one hundred measures were analyzed at either a preliminary or detailed level. Suggested measures came from several sources, either from:

(a) the Clean Air Act and subsequent guidance from EPA;

(b) DVRPC staff;

(c) citizen and agency advisory groups which serve DVRPC; or

(d) interests affected by the measures.

The descriptions of the methods which follow are brief, particularly the methods of technical analysis. For a more detailed exposition of methods, consult the supplementary reports listed in Appendix A.

2.2.1 Technical approach

The Clean Air Act requires that SIP submittals include an analysis of each of the alternative measures considered during SIP development. This plan summarizes the findings of the analyses in conformity with various EPA guidance documents. This section describes the analysis of individual measures; Section 2.5 seeks to describe the impacts of all recommended measures taken together. The section which follows is divided into three parts. The first describes the preliminary analysis, the second the detailed studies and the third the decision to recommend or not.

(a) Preliminary analysis

Between the award of the grant in November 1979 and September of 1980, DVRPC staff performed a preliminary analysis of 75 measures. (Many other measures were studied which appeared during the detailed studies as variations of the measures surviving the preliminary analysis.) The study was known among its participants as the "reconnaissance-level analysis." The study sought to provide sufficient information so that the Transportation TAC could screen out those measures which showed little promise of succeeding in contributing to reduced emissions.

The most important aspect of the preliminary analysis was the assumptions which went into defining of the extent of application. Clearly, the more ambitiously a strategy is pursued, the more emissions will be reduced. In this case the object was to assume a reasonable application of the measure, one which, once a part of the SIP, could be programmed, designed, funded and constructed (or initiated) before 1987.

Once defined, the impacts of each measure were calculated. For emissions, EPA's MOBILE 1 factors were used. Costs were often difficult to project because of the lack of specificity in the definition. Social, economic and environmental impacts were stated qualitatively and depended, in large part, on the observations offered by public and agency reviewers. (See Section 2.2.2 for a summary of public participation in the preliminary analysis.) The Reconnaissance-level Analysis is described in Appendix C as Reference 19.

(b) Detailed analyis

Those strategies which survived the screening at the conclusion of the preliminary analysis were subjected to a detailed analysis. These studies were conducted by DVRPC staff, member governments, or consultants. DVRPC studied most non-transit related measures, including: (1) educational programs; (2) bicycle provisions; (3) ridesharing programs; (4) high-occupancy vehicle incentives; and (5) park & ride lots at suburban locations. Under contract to DVRPC, private consulting firms studied transit-related measures. Transit strategies which passed the preliminary analysis phase included those which: (1) provided new services; (2) promoted patronage through information and incentives; (3) improved the attractiveness of vehicles and stations; or (4) enhanced the reliability of the system. Programs and projects already on the TIP or operating agency capital programs and entirely new programs and projects were evaluated.

Several member governments assumed responsibility for detailed studies. The Philadelphia Department of Public Property conducted study of preferential treatment of transit vehicles on Roosevelt Boulevard; the Philadelphia City Planning Commission conducted a comprehensive study of parking policy in Center City; a companion study by Philadelphia Air Management Services developed a model for predicting CO concentrations in Center City; New Jersey Department of Transportation, with assistance from Trenton and Mercer County, conducted a "Trenton Area Study" examining various strategies for reducing emissions; and affected local governments in New Jersey studied ways of eliminating suspected local carbon monoxide hotspots. In each of these studies, consulting firms provided technical assistance.

The purpose of the detailed studies was to clearly define candidate measures for inclusion in the SIP and to prepare a summary of impacts sufficient for decision-makers to determine which measures ought to be adopted in the final plan. The information on each candidate measure was summarized in the forms similar to those presented in Section 2.4, which now includes only those which have been adopted as part of the plan. Listed below are the attributes of the measures as they appear on the forms. A discussion of the technical approach used in completing each of the entries is included.

Project Number	The first project number is PA 3-1. PA indicates the project applies only to Pennsylvania and is included in the Pennsylvania SIP. NJ indicates New Jersey projects. The first number indicates the type of project according to categories established in Section 108 of the Clean Air Act. The second number identifies the specific project of this type.
Title	The title is a short description used for convenience and refers to the particular project described in the following section.

Description	The description includes all specifics of the project, for example, number of vehicles, the route numbers affected, facility locations, or the level of effort.
Schedule	In many cases, only the date on which the emission reductions begin to take place are included. In the commitment to implement a project, the responsible agencies may include interim milestones such as "engineering completed" or "funding obtained."
Transportation Impacts	The focus of the detailed studies has been on assessing the impact of the project or program upon transportation patterns. The following five transportation parameters have been studied: Person trip reduction is only affected by the educational program to reduce unnecessary trips. Otherwise, it has not been the objective of this planning effort to reduce the total amount of travel. (In the case of the educational program, total population reached by the program was estimated and multiplied by the percent of the audience assumed to reduce their tripmaking. Among those who reduce their tripmaking, a reduction in the rate was estimated.) Next, changes in mode were estimated. In each case the specific switch was noted, e.g., auto driver to transit passenger or auto driver to auto passenger. The approaches to estimating modal shift were quite varied and appropriate to the project; the reader should refer to various supplementary documents which explain the methodology fully. In most cases where traditional transportation variables were affected elasticites of demand were applied, default values from other sources being used where Philadelphia-specific values could not be readily obtained. Many of the changes in mode for New Jersey transit strategies were based on the results of a 700-person telephone survey conducted in August, 1981 specifically for this planning effort. Carpool and vanpool formation was estimated on the basis of local experience. VMT (vehicle-miles of travel) reduction was based on the average length of the trips calculated to be foregone or shortened in the previous step. Fuel reduction was based on the average fuel consumption per mile for the fleet in the year 1987. Lastly, travel-time impacts were described as appropriate to the project. Some impacts cited are changes in speed, delays, increases in headways and changes in waiting time.
Air Quality Impacts	Three pollutants were considered in this analysis. Hydrocarbon emission reductions were estimated for the first year of operation and for each succeeding year until 1987. Estimates are for July in each year, in the height of the ozone season. Carbon monoxide reduction is estimated for 1983 (when the present Pennsylvania SIP requires attain-

ment) and for 1987. Estimates are for December, when CO concentrations are greatest. Nitrogen oxides (as NO_2) reduction estimated for 1987. This pollutant is not currently in violation of standards. All reduction estimates are in kilograms per day (kg/day) and were calculated using EPA's MOBILE 2 emission factors.

Regional Development Impacts

Four types of impacts are considered. Typical land use impacts include a propensity to attract high density developments or a reduced need for parking. Economic impacts include secondary effects beyond the cost of the project such as a reduction in taxes, or increased sales at adjacent commercial establishments. Social impacts may include a reduction in accidents, crime or vandalism. Few environmental impacts beyond those upon air quality have been cited. DVRPC's Regional Development Guide was used as a checklist for assessing impacts.

Capital and Operating Costs

Unlike the preliminary analysis, considerable effort was spent in the detailed analysis to present reliable cost estimates. Capital costs from federal, state and local sources were estimated separately, or drawn from existing grant applications or capital programs. The life of the project is the period until the project would need to be replaced or substantially rebuilt or renovated. Typical life-spans were assumed for transportation facilities, such as 15 years for new buses. No projects were assumed to have a life greater than 30 years. The life of the project was used to calculate an annual capital cost, which can be assumed to be in 1982 dollars. A second annual cost was calculated for the change in O&M (operations and maintenance) costs. In many cases, an O&M cost exists for the service in its present form, so only the incremental cost or savings attributed to the project is considered. In the case of new projects, the entire O&M cost is shown. Total annual cost is the sum of the annual capital cost and the change (+ or -) in O&M costs.

Cost Effectiveness

The cost effectiveness is calculated by dividing the annual cost by the daily level of hydrocarbons reduction (in kg). The number provides some guidance as to the most efficient ways to attain air quality goals. However, it should be noted that most measures recommended in this plan have multiple benefits, and are not initiated solely for air quality. Inasmuch as it is not possible to determine which portion of the expenses should be attributed to reducing emissions, the cost-effectiveness should be considered along with other indicators such as available funding, other impacts, and the ability and willingness of the implementing agencies.

Responsibilities	Each agency responsible for planning, programming, constructing and operating the project is listed.
Commitments	Each agency having responsibility for a phase of the project has been asked to offer a firm and written commitment that it will execute its responsibilities. These commitments are conditioned by certain external circumstances such as the absence of more urgent use of its resources or the availability of necessary outside funding. Reproduction of commitment letters can be found in Appendix D.
References	The primary reference provided is the detailed planning report for the project, being one of the supplementary documents to this plan. Where information used in the summary is drawn from other reports, these too are referenced.

2.2.2 Consultation with Interested Parties

In early 1980, EPA and USDOT published joint guidelines for public participation in transportation-air quality planning. The process described in the following paragraphs was consistent with those guidelines. The reference to "consultation with interested parties" acknowledges that widespread "public" participation is virtually impossible in a planning program such as this because of lack of an issue of urgent concern to most people. Certain parties (or publics) are affected more directly, however, and the participation of these groups has been actively pursued. These parties may include implementing agencies, such as SEPTA and New Jersey Transit; groups whose members are affected by the measures themselves, such as the AAA clubs; and groups representing persons affected by air pollution, such as the Delaware Valley Citizens' Council for Clean Air. Nevertheless, DVRPC has attempted to raise the general public's awareness of the necessity of changes in our transportation habits to improve air quality. The most appropriate way of doing this, it has been concluded, is to tap the mass media. The organization established for public participation and its application to the past and future planning activities is described below.

(a) Organization and approach

As part of its grant application for transportation-air quality planning, DVRPC prepared a Work Program for Public Participation (Reference 36), revised January 7, 1980. Citizens and member government representatives worked with DVRPC staff in the preparation of the program. The program was approved by the DVRPC Board and by EPA. For more details than is to be found below, consult Reference 36.

Prior to development of the work program, member governments of DVRPC delegated the designation of a primary committee to guide the development of the 1982 SIP revision. The strongly favored alternative was the designation of the Transportation Technical Advisory Committee (TAC), the conferees believing that the TAC represented the best committee to successfully integrate air quality objectives into the transportation planning process. The TAC includes transportation professionals from DVRPC member governments as well as EPA, UMTA and FHWA. It also includes citizen members and representatives of operating authorities. One of the TAC's first actions in June 1979 was to appoint an ad hoc subcommittee to assist staff in developing a program of public participation. In addition, the subcommittee has met a number of times (usually quarterly) since the completion of the work to review progress of the program and to recommend changes.

DVRPC's three then-existing citizen committees were to be kept informed of the transportation-air quality planning (T-AQP) progress. The citizen committees advise the TAC, Planning Coordinating Committee and Board on all matters of regional interest. In order to assure more direct contact between the citizen committees and the TAC, a representative from each of the citizen committees was made a voting member of the TAC. In addition, the independent Citizen Transportation Committee maintained its seat on the TAC.

The Work Program lists 28 interests or publics likely to be affected by or be vitally interested in T-AQP. Over one hundred individual organizations were listed which could represent one or more of the interests. This list has formed the basis of a mailing list which has swelled to over 1500 names to which a monthly newsletter, AIR MAIL, has been circulated. Three of the organizations named by the subcommittee were felt to have a potential for multiplying the effect of the public participation program — the Delaware Valley Citizens Council for Clean Air (CAC), the League of Women Voters (LWV) and the Keystone Automobile Club (KAC). The first two organizations have received grants over the past three years to assist in the conduct of the program. Keystone declined a grant, but nevertheless has contributed greatly to the effort. Examples of the kinds of work these organizations have done follow in parts (b) and (c) of this section.

At important junctures in the planning the work program calls for dissemination of information to the public at large followed by an opportunity for the public to respond. The first part of this effort relies on television and radio appearances, through press releases to all news media, and notice through distribution of reports and notices in the publications of the CAC, LWV and KAC. Public meetings follow this period of information dissemination permitting a forum for discussion between study participants and the public.

(b) Application

The most important way in which DVRPC has maintained an awareness of transportation-air quality planning (TAQP) has been through the publication of AIR MAIL. Each issue of the newsletter lists major accomplishments during the previous month, gives notice of meetings and other events during the upcoming months and presents one or more feature articles on some aspect of the planning. Twenty-two issues have been produced.

Month	Feature Article
February 1980	Request for suggestions for transportation control measures
March 1980	Background information on T-AQP

Month	Feature Article
April 1980	Progress report on the reconnissance-level analysis
May 1980	TSM and clean air
June 1980	Progress report on the reconnaissance-level analysis
July 1980	Notice of public meetings and request for comments
September 1980	Report on citizen comments at public meetings
SPECIAL	Carbon monoxide studies
October 1980	Disposition of strategies from reconnaissance-level analysis
SPECIAL	Impacts of ozone
November 1980	Task forces formed for detailed studies
Dec/Jan 1980/81	Transit studies
March 1981	Air quality and health
April 1981	Proposed changes to Clean Air Act
May 1981	Efficient driving
Jun/Jul 1981	Commuter Saving Time
August 1981	Park and Ride
September 1981	Emission reduction target
October 1981	Bicycle provisions
March 1982	Summary of completed draft Plan
March/April 1982	Notice of public hearings and request for comments
June 1982	Announcement of Plan adoption; changes from draft

AIR MAIL issues are collected in Reference 35.

The first issue of AIR MAIL requested readers to suggest transportation controls which they believed could help reduce emissions. Similar requests were made in presentations to DVRPC citizen committees and the Transportation Techical Advisory Committee (TAC) using "Issue Paper No. 1" (Reference 34). As a result of this call, ten additional measures were added to the list of 65 measures which DVRPC had promised in the 1979 SIP Revision to study in preparation for the 1982 SIP. Staff then believed that it had a truly comprehensive list of possible strategies to study.

During the spring of 1980, DVRPC performed its preliminary or "reconnaissance-level analysis." Three joint meetings of the citizens committee were held in the spring of 1980, each presenting the results of the staff's preliminary analysis of 25 measures. Citizens asked to comment on the analysis and to provide observations on the impacts which were overlooked in the staff analysis. These meetings were typically attended by 30 to 40 individuals and were successful in their purpose despite the lengthy agenda. At the conclusion of the citizen meetings, Issue Paper No. 2 (Reference 19) was published for release to the general public.

Three public meetings, sponsored jointly by DVRPC and the League of Women Voters, were held in July for the purpose of presenting the 75 strategies for discussion. A panel presentation with representatives from local government, health, environmental, automobile and transit interests was the main feature of each meeting. The panel was preceded by a DVRPC presentation which highlighted the staff's preliminary analysis and was followed by a request for citizens to complete a questionnaire indicating their reaction to each of the measures on a five point scale ranging from strongly opposed to strongly supportive. Although the meetings were considered successful in their format, attendance was poor despite vigorous campaigning; the three meetings drew a total of only 35 people.

The Transportation TAC members were also provided with draft copies of the analysis and shortly before the public meeting held a special meeting in which three work groups performed a final review of one-third of the measures before release to the public. The TAC also completed the same questionnaire as the public. At a special meeting in August, 1980, the TAC was presented with the results of the survey (tabulated separately for TAC members and the public) and with summaries of the comments made by the public as well as copies of written comments received by DVRPC. The TAC then chose those strategies which by reason of effectiveness and feasibility appeared appropriate to study in detail. At its regular September 1980 meeting, TAC confirmed its decision by formal motion.

Work programs were developed for the detailed studies during late 1980; the studies themselves occurred mostly during calendar 1981. (Some detailed studies began earlier, e.g., those for which a need had been perceived during the 1979 SIP revision planning.) In the case of the following detailed studies, steering committees were established:

(1) Trenton Area Study
(2) Center City Parking Study
(3) Roosevelt Boulevard Preferential Treatment of Transit Study
(4) Pennsylvania Transit Strategies
(5) New Jersey Transit Strategies
(6) Bicycle Provisions
(7) Educational Programs

Typically, these steering committees were composed of TAC members whose jurisdictions were affected by the study, representatives of other affected interest and volunteer citizens. The committees met between three and six times. Considerable work was asked of the members in reviewing reports, making choices between alternatives and finally recommending or rejecting strategies for this draft plan. In cases where a steering committee was not established, staff arranged for meetings with individuals and agencies affected by the project.

The first part of 1982 was devoted to another intensive effort at involving the public, this time in the decision to determine a transportation and air quality plan for the region. In January the staff of the DVRPC released a draft plan which contained a series of candidate measures recommended for inclusion in the plan. The recommendations had been made jointly between staff and the various steering committees. DVRPC staff, with the assistance of the Clean Air Council (CAC) and League ofWomen Voters (LWV), then launched a drive to increase public awareness of the proposals. The effort culminated in adoption of a plan in May.

(Simultaneously, staff met with each implementing agency to secure commitment to carry out each recommended project. In every case the commitments obtained were qualified in such a way as to nullify the commitment if funding from outside agencies could not be obtained. Most of the projects recommended in the draft were committed to by the implementing agency. If no commitment could be obtained, the project was removed to the reserved category for possible future inclusion in the plan. Commitments are summarized in the project descriptions later in this section. Copies of the letters of commitment are found in Appendix D.)

The use of mass media was stressed in the review of the draft plan. In the period February through April, four television programs were scheduled in which participants described the health impacts of transportation-related pollution, the need for emissions abatement, and the measures recommended in the plan. The arrangements for these programs were made by the LWV, which participated in the interviews, along with DVRPC and health experts. In each case, mention was made of upcoming meetings and hearings on the plan. The CAC was successful in arranging for articles to appear in area newspapers and the newsletters of many civic organizations. Very useful was a news story about the plan which was broadcast several times on the day before one of the public hearings on KYW-radio, the region's most popular station.

Three public meetings were held in mid-March in Philadelphia and suburban locations in Pennsylvania and New Jersey under the auspices of the LWV. At each, presentations were made by DVRPC staff explaining the measures. A discussion period followed and the meeting concluded with a presentation by the LWV on how to testify at public hearings. Attendance at these meetings, like the ones which concluded the reconnaissance-level analysis were disappointing; only about ten individuals were introduced to the planning program.

The public hearings held March 30th in Philadelphia and April 15th in Voorhees, New Jersey were much better attended. Over 50 people attended and 38 offered testimony. Most testifiers praised the plans objectives and urged its adoption. The most commonly heard criticism was that the plan did not go far enough. Several testified that, in particular, bicycle measures should be expanded. Copies of the hearing transcripts, along with written testimony, are available to the public; see Reference 42. Summaries are also available which also included brief staff responses to each point made in testimony; see Reference 43.

The Transportation TAC was briefed on the draft plan shortly after its publication Later, state caucuses of TAC members met to discuss the plan as it related to their state. In April, following the public hearing, the TAC met in a special session to draft a resolution for the Board. TAC continued to work on the resolution at its regular May meeting and sent the resolution to the Planning Coordinating Committee (PCC) without recommendation because of several issues which the TAC was unable to resolve.

The PCC, at TAC's request, resolved the outstanding issues and forwarded the resolution to the Board with a recommendation of favorable action. After a lengthy discussion, the Board adopted the plan with one negative vote. The Board's resolution is reproduced following the title page of the plan.

Other notable public participation activities have included:

(1) A seminar on public participation was hosted by DVRPC at the request of EPA. The three day seminar was conducted by the Institute of Participatory Planning, many of whose approaches were incorporated into the DVRPC's work program. The seminar attracted planners and local elected officials from all parts of the Northeast, including many from the region.

(2) Two television programs featured discussion of DVRPC's planning for air quality in New Jersey. One half-hour program produced by the League of

Women Voters was devoted to a comprehensive look at the ozone problem and possible solutions. A second 15 minute segment of a news program discussed the results of the survey of non-transit users in Burlington, Camden and Gloucester counties.

(3) The Clean Air Council sponsored two seminars on the health impacts of transportation-related pollutants. In each, a noted local television news reporter asked questions of a panel of four experts from the health and environmental sciences. The results of these discussions have been documented by the Council (see Reference 33).

(4) The Keystone Automobile Club published two feature articles on transportation-air quality in its monthly newspaper, Keystone Motorist. Circulation is approximately a quarter-million. One article provided general information on the program; the second explained the purpose of the educational programs DVRPC was developing. A survey accompanying the second article provided feedback to DVRPC critical to determining the best means of educating the public and the likely success the program.

(5) The League of Women Voters wrote and arranged for the distribution of 80,000 brochures in the program to the general public — specifically, Sears customers. A mail-back questionnaire will be used to assess the likeliness of success of several programs, as well as provide DVRPC with the names and addresses of individuals who would like to have additional information on several of the projects and programs. About 250 responses were received. Further information on past public participation activities can be found in the T-AQP Annual Reports for 1980 and 1981 (References 31 and 32, respectively).

2.3 Decision to Recommend and Index of Analyzed Strategies

Each of the measures which have been studied either in the preliminary or detailed analysis, has been classified in one of three categories: recommended, reserved, or rejected. The classification was initially done on the basis of staff's technical analysis and past public participation. Recent public participation and committee and DVRPC Board action resulted in most of the recommended measures a few reserved measures being adopted as elements of the regional Transportation-Air Quality Plan. A discussion of each of the three categories follows:

Recommended projects appear to be effective and feasible to initiate before 1987. They consist of projects in which either (1) primary objective is air quality improvement, (2) the primary objective is transportation improvement, or (3) the primary objective is system maintenance. Among the air quality improvement projects are ridesharing projects, or educational programs to reduce unnecessary trips and excessive idling. Although other benefits exist, the main objective is to reduce emissions.

Transportation improvement projects represent new facilities or major improvements in existing services not required for maintenance of the extant transportation system. Examples are new rail lines and stations, substantial modernization and redesign of existing stations, or transit marketing measures. The objectives include: (1) improved service to present users who will benefit from better travel times, amenities; etc., (2) improved transportation for new riders who are diverted from autos, thereby reducing congestion and improving safety, etc.; (3) economic development such as generation of new jobs, strengthening of business development, etc.; and (4) noise reduction and air quality benefits. In most cases, one of the first three objectives drives the project to fruition, but the air quality benefits, although a by-product, are substantial and should be counted upon to reduce emissions.

System maintenance projects are necessary for the proper functioning of the transportation system, such as highway and transit infrastructure maintenance or replacement of transit vehicles. Where standards of maintenance are kept high, projects of this type would not result in a ridership gains. In the Philadelphia region, deferred maintenance has resulted in depressed ridership levels. The improvements in amenity, speed, comfort, safety and reliability will attract more riders and are therefore beneficial to air quality.

The second category in which measures have been placed is reserved measures. The reserved measures are those which have demonstrated or assumed benefits but which for one of several reasons is impractical to recommend at this time. They include: (1) projects which yield a substantially smaller benefit than other similar measures in the recommended list and in which implementation is problematic; (2) projects which, although likely to be readily implemented, yield very small reductions and so are not worth a continuing effort to assure commitments to initiate; (3) projects for which the benefits are uncertain although likely to be small. Greater experience with this type of project in other regions or in local pilot projects may be necessary before inclusion in the SIP revisions can be recommended.

The Contingency Plan discussed in Section 3.4 explains how DVRPC will use the reserved measures in the event of a shortfall in "reasonable further progress" toward attainment. The reserved measures themselves are discussed in Appendix B, as they apply to Pennsylvania and New Jersey.

Rejected strategies, the third category are those which are clearly inferior as methods to reduce emissions or are impractical to initiate before 1987. They appear to fall into one of the five types: (1) those which could provide substantial emission reduction but which are politically, institutionally or financially infeasible, e.g., gasoline rationing or one-way bridge tolls; (2) those which might allow some small benefits but which face considerable opposition, e.g., limiting restrictions on right-turn-on-red; (3) those which yield negligible or unquantifiable air quality benefits, e.g., walkways or traffic information signs; (4) those which are believed to result in emission increases, e.g., dial-a-ride services; and (5) those whose application is preempted by existing, similar projects; e.g., the Chestnut Street Transitway in Philadelphia and the State Street Mall in Trenton may have exhausted the application of auto-restricted zones for the region's central business districts. Rejected measures are described in Appendix C.

Four of the recommended strategies are projects which were included in the 1979 SIP Revision for Pennsylvania but which have been delayed past 1982. (Reference 28, pp 3-3, 3-4) These projects are listed below with indication of the changes in schedule. They also include revised emission reductions which have been calculated again to reflect lower population projections, MOBILE 2 emission factors and a more precise estimate of their impact on modal switches and vehicle-miles of travel.

Center City Commuter Connection

- o Description of project now includes ancillary projects Market Street East Intermodal Connection (TIP #133), Market Street East Joint Development (TIP #151) and Commuter Railroad Facilities Coordination (TIP #238B) in addition to tunnel (TIP #406).
- o Schedule is extended to July 1984 from December 1983.
- o Auto VMT reduction/day is now 109,000 rather than 145,000.
- o HC reduction is now 197 kg/day in 1985 instead of 550 kg in 1983.
- o Cost is now $460M instead of $307M.

Airport High Speed Line

- o Project now includes Eastwick and Civic Center Stations
- o Opening is extended to December 1983 from 1982.
- o Auto VMT reduction/day is now 30,000 rather than 34,000.
- o HC reduction is now 44 kg/day in 1984 rather than 145 kg in 1982.
- o Cost is now $114M instead of $73M.

Newtown Commuter Rail Line Electrification

- o Schedule is extended to 1987 from 1982.
- o Auto VMT reduction/day is now 21,600 instead of 104,000.
- o HC reduction is now 31 kg/day in 1987 rather than 391 kg in 1982.
- o Cost is now $12M instead of $3.6M.

Route 66 Trolley Line Extension

- o Schedule is extended to 1983 from 1982.
- o Auto VMT reduction/day is now 4,500 rather than 6,000.
- o HC reduction is now 13.7 kg/day in 1983 instead of 27 kg in 1982.
- o Cost is now $2.6M instead of $519,000.

The list which follows indicates the disposition of each of the strategies DVRPC has studied. "REC" indicates the measure is recommended for inclusion in the SIP of either Pennsylvania (PA) or New Jersey (NJ), as shown. "RES" indicates a "reserved" measure for possible future implementation in one of the states. "REJ" indicates the measure is rejected as reasonably available in both states. Categories beginning with an (A) or (B) are prescribed in the law. (C) indicates new measures not mentioned in the law.

INDEX OF
AIR QUALITY CONTROL STRATEGIES

Categorized as in the 1977 Amendments to the Clean Air Act, Section 108(f)(1)

Project category/project name	Disposition REC	RES	REJ	State	Page
(A)(i) MOTOR VEHICLE EMISSION INSPECTION AND MAINTENANCE (By agreement, the responsibility of the states, and not DVRPC)					
(A)(ii) VAPOR EMISSION CONTROL FOR FUEL TRANSFER OR STORAGE (By agreement, the responsibility of the states, not DVRPC)					
(A)(iii) IMPROVED PUBLIC TRANSPORTATION					
New Commuter Rail Vehicles		X		PA	A-1
New Rapid Transit Vehicles	X			PA	2-20
New Rapid Transit Vehicles, Supplementary Order		X		PA	A-1
New Light Rail Vehicles	X			PA	2-22
New Light Rail Vehicles for North Philadelphia and the Norristown Line		X		PA	A-12
New Buses	X			PA	2-24
Rehabilitated Rapid Transit Vehicles		X		PA	A-1
Rehabilitated Light Rail Vehicles		X		PA	A-12
Rehabilitated Buses		X		PA	A-2
SEPTA Rapid Transit and Commuter Rail Vehicle Overhaul			X		B-1
Premium Bus Service		X		PA	A-2
Park-and-Ride Express Bus Service		X		PA	A-11
Park-and-Ride Express Bus Service	X			NJ	2-62
Woodbury and Turnersville Park-and-Ride	X			NJ	2-64
New Bus Routes		X		NJ	A-13
Shuttle Service between State Offices		X		NJ	A-19
Improved Bus Service Frequency and Route Modifications		X		PA	A-3
Improved Bus Service Frequency and Route Modifications		X		NJ	A-13
Extension of NJT Route in Philadelphia	X			NJ	2-58
Extension of Norristown Commuter Rail Line			X	PA	B-30
Newtown Commuter Rail Line Electrification (also in 1979 PA SIP)	X			PA	2-34
Further Electrification of Rail Lines			X		B-1
Route 66 Trolley Line Extension (also 1979 PA SIP)	X			PA	2-32
Park-and-Ride Express Bus Service for Trenton		X		NJ	A-19
New Buses	X			NJ	2-50
Rehabilitated Buses	X			NJ	2-52
Route Y and 59b Electrification		X		PA	A-3

	Disposition				
	REC	RES	REJ	State	Page
Commuter Rail Infrastructure Improvements		X		PA	A-4
SEPTA Rapid Transit and Light Rail Infrastructure Improvements			X		B-2
PATCO Infrastructure Improvements			X		B-2
Rapid Transit and Light Rail Station Renovation	X			PA	2-26
Frankford El Reconstruction and Station Renovation		X		PA	A-4
Market Street West Station		X		PA	A-4
30th Street Commuter Rail Station		X		PA	A-5
Suburban Commuter Rail Station Renovation		X		PA	A-5
Regionwide Shelters and Signs	X			PA	2-28
Bus Shelters		X		NJ	A-13
Bus Stop Signs and Marketing Program		X		NJ	A-14
Bus Stop Relocation		X		PA	A-5
Bus Stop Relocation		X		NJ	A-14
Camden Transportation Center		X		NJ	A-17
Coordination of Transit Service		X		PA	A-6
Coordination of Transit Service		X		NJ	A-14
Two-Way Bus Radios	X			NJ	2-54
Improved On-Time Performance	X			NJ	2-56
Transit Safety and Security	X			PA	2-30
Transit Promotional Programs		X		PA	A-6
Differential Peak/Off-Peak Fare Structure			X		B-2
Seasonal Fare Reduction		X		PA	A-11
Free Intra-CBD Rides on All Regularly Scheduled Buses			X		B-4
Transit Permit		X		PA	A-6
Transit Fare Prepayment for SEPTA Transit System			X		B-5
Discounted Multi-Zone Monthly Pass Program		X		NJ	A-15
Rationalization of NJT Fare Structure	X			NJ	2-60
SEPTA Rapid Transit and Light Rail Fare Collection System			X		B-5
Replacement of PATCO Station Ticket Vending Equipment			X		B-5
Improved Management-Labor Relations			X		B-5
Demand-Responsive (Dial-a-Ride) Service			X		B-6
Subscription Feeder Service to Transit Stations			X		B-7
Shuttle to Activity Centers			X		B-8
Use of School Buses for Other Purposes			X		B-8
Taxis Operating as Jitneys			X		B-9
Register-Ride Program			X		B-10

(A)(iv) EXCLUSIVE BUS AND CARPOOL LANES AND AREAWIDE CARPOOLS

	REC	RES	REJ	State	Page
Preferential Signals for Transit Vehicles		X		PA	A-7
Exclusive Lanes for Transit Vehicles		X		PA	A-7

	Disposition REC	RES	REJ	State	Page
Exclusive Southbound A.M. Peak Hour Bus Lane on Roosevelt Boulevard		X		PA	A-10
Other Preferred Treatment Measures for Buses and HOVs on Roosevelt Boulevard			X	PA	B-30
Ridesharing Program, Employer- and Community-based	X			PA	2-36
Statewide Ridesharing Program	X			NJ	2-66
Use of State Pool Vehicles for Carpools		X		NJ	A-18
State Leasing of Vans for Employee Ridesharing		X		NJ	A-18
Parking Measures to Encourage Ridesharing by State Workers		X		NJ	A-17
Exclusive Lanes for High Occupancy Vehicles			X		B-23
HOV Lanes on US 130		X		NJ	A-15
(A)(v) LIMITING ROADS AND SECTIONS OF METROPOLITAN AREAS TO COMMON CARRIERS					
Auto-Free Zones			X		B-15
Auto Restricted Zones			X		B-13
(A)(vi) LONG-RANGE TRANSIT IMPROVEMENTS - NEW FACILITIES AND MAJOR CHANGES IN EXTANT FACILITIES					
Airport High-Speed Line (also in 1979 PA SIP)	X			PA	2-38
Center City Commuter Connection (also in 1979 PA SIP)	X			PA	2-40
PATCO Extension to Berlin-Atco		X		NJ	A-16
PATCO Extension to Maple Shade and Bellmawr		X		NJ	A-16
(A)(vii) CONTROL OF ON-STREET PARKING					
Center City Parking Policies	X			PA	2-42
Increased Off-Street Parking and Regulations of On-Street Parking (except in Philadelphia CBD)			X		B-18
(A)(viii) NEW PARK-AND-RIDE LOTS AND FRINGE PARKING					
PATCO Lindenwold Station Parking	X			NJ	2-70
I-295 Interchange at PATCO Woodcrest Station	X			NJ	2-68
Joint Park-and-Ride Fares			X		B-16
Reduced Off-Peak Parking Fees			X		B-17
Fringe Parking			X		B-16

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(A)(ix) PROGRAMS TO LIMIT ROADS/AREAS TO PEDESTRIANS OR NON-MOTORIZED VEHICLES					
Pedestrian Malls			X		B-14
Walkways			X		B-12
(A)(x) EMPLOYER PROGRAMS TO ENCOURAGE HOV, TRANSIT, BICYCLING, AND WALKING					
Employer-based Subsidized Transit Pass Program		X		PA	A-8
(A)(xi) BIKE LANES AND SECURE BICYCLE STORAGE					
Preferred Bicycle Route Map	X			PA	2-44
Preferred Bicycle Route Map	X			NJ	2-72
Other Bicycle Measures	X			PA	2-46
Bicycle Planning and Design Guidelines	X			NJ	2-74
(A)(xii) STAGGERED WORK HOURS					
Flextime Promotional Effort			X		B-24
(A)(xiii) DIFFERENTIAL ROAD USER CHARGES/ TOLLS					
Reduced Bridge Tolls for High-Occupancy Vehicles		X		PA	A-9
Reduced Bridge Tolls for High-Occupancy Vehicles		X		NJ	A-16
(A)(xiv) EXTENDED IDLING CONTROL (See (C)(vi) OTHER EDUCATIONAL PROGRAMS					
(A)(xv) IMPROVEMENTS IN TRAFFIC CONTROL					
Construction of Missing Highway Links			X		B-19
One-Way Streets			X		B-19
Roadway Improvements			X		B-20
Synchronized Traffic Signals		X		PA	A-9
Synchronized Traffic Signals		X		NJ	A-16
Intersection Improvements		X		PA	A-10
Intersection Improvements at CO Hot Spots	X			NJ	2-76
Other Intersection Improvements		X		NJ	A-16
Left-Turn Restrictions			X		B-21
Elimination of Four-Way Stops			X		B-21
Relaxed Restrictions on Right-Turn-on-Red			X		B-21
Blinking Signals during Late Night Hours			X		B-21
Advance Traffic Information			X		B-22
New and Improved Information Signs			X		B-22
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	Disposition				
	REC	RES	REJ	State	Page
One-Way Bridge Tolls			X		B-12
(A)(xvi) CONVERSION OF FLEETS TO CLEANER ENGINES AND FUELS: FLEET OPERATIONAL CONTROLS					
(See Route Y and 59b Electrification under IMPROVED PUBLIC TRANSPORTATION)					
(A)(xvii) RETROFIT EMISSION CONTROL ON VEHICLE (By agreement, the responsibility of the states, and not DVRPC)					
(A)(xviii) REDUCE COLD START EMISSIONS					
(See (C)(vi) OTHER EDUCATIONAL PROGRAMS)					
(B) EPISODIC CONTROLS			X		B-25
(C)(i) LAND USE CONTROLS					
High-Density Development Adjacent to Transit			X		B-26
Review of Development Plans for Indirect Sources			X		B-26
(C)(ii) TEENAGE DRIVING					
Reduced Student Driving			X		B-26
Equalization of State Minimum Driving Age			X		B-27
(C)(iii) GASOLINE RATIONING			X		B-27
(C)(iv) AUTOMOBILE PRICING MEASURES					
Increased Fuel Taxes			X		B-28
Increased Registration Fees			X		B-29
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(C)(v) CONTROLS ON TRUCK MOVEMENT					
Restricted Truck Deliveries			X		B-20
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(C)(vi) OTHER EDUCATIONAL PROGRAMS	Disposition REC	RES	REJ	State	Page
Educational Program (to Eliminate Unnecessary Trips, Reduce Idling and Cold Start Emissions)	X			PA	2-48
Educational Program (to Eliminate Unncessary Trips, Reduce Idling and Cold Start Emissions)	X			NJ	2-78

PROJECT PA: 3-1

NEW RAPID TRANSIT VEHICLES

Description	This project involves the purchase of 125 new rapid transit cars for the Broad Street Subway, and some maintenance equipment and shop alterations for servicing the new cars. The acquisition of modern attractive, air-conditioned, high-performance vehicles, replacing obsolescent 44- to 54-year old subway cars, will provide a sufficient number of cars to operate the line.
Sites	The new cars will operate on the Broad Street and Ridge Avenue lines in Philadelphia.
Schedule	Production cars should begin to arrive in March, 1982; all vehicles should be in service by March, 1983.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	28,172
Auto VMT reduction/day	101,853
Gallons of gasoline saved/day	5,500

Travel time impacts:

The improved acceleration of the new cars will allow a reduction in running time on Broad Street by 11 minutes, resulting in a 16.2% decrease in line-haul time for users. Also, the availability of more cars will allow reduced headways during peak hours, and improved reliability of the equipment will result in decreased headway variability. Both factors will reduce waiting time, and hence total trip time.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
0	311.6	253	219.1	194.2	175.7

Kg/day CO reduction in December 1983:	4314.6
" " " " " 1987:	2764.8

Kg/day NOx reduction in 1987:	174.9

Regional development impacts

Land use:

Upgrading of the Broad Street subway may favor increased high-density development along the line.

Economic:

None cited.

Regional development impacts (cont'd)	Social: The development of more attractive and comfortable equipment, with more seating and standing room provided during rush hour (more and/or longer trains) should be instrumental in increasing passenger respect for the Broad Street line, and may help reduce incidents of vandalism. Improved safety allowed by the new cars will help to overcome the fear some passengers have of using the subway. Environmental: None cited.

Capital and operating costs and funding sources	Capital costs, federal	\$ 88,078,000
	Capital costs, state	\$ 19,935,000
	Capital costs, local	\$ 3,666,000
	Capital costs, total	\$111,679,000
	Life of project	30 years
	Annualized capital cost	\$ 3,722,633
	Change in annual O&M costs	Not available (1)
	Total annual project cost	Not available

Notes: (1) Although increased operating speeds will allow more productive use of train crews, decreased load factors may result in an increase in operating and maintenance costs as more and longer trains are run. Air conditioning may result in an increased power demand. The operation of modern equipment will allow reduced materials costs, as it will no longer be necessary to fabricate obsolete parts in SEPTA shops.

Cost effectiveness	Total annual project cost/kg HC reduced in 1987: \$21,187 (Capital costs only)
Responsibilities	The City of Philadelphia will be responsible for purchasing the new cars; SEPTA will be responsible for their operation.
Commitments	Philadelphia Department of Public Property will commit to placing all 125 cars into operation. See Appendix D.
References	Reference 1, pp. 2-20 to 2-23, 2-29, 3-2 to 3-4 Reference 23, p. 8 Reference 25, pp. 7, 43

PROJECT PA: 3-2

NEW LIGHT RAIL VEHICLES

Description	This project includes the purchase of 141 light rail vehicles, of which 112 would operate on the SEPTA City Division, replacing 40- to 50-year old air-electric PCC cars. The other 29 cars on this order would be for the Red Arrow Division, replacing Master Unit, Brilliner, and PCC-derived equipment (respectively 50, 41, and 33 years old). The new cars will result in greatly improved amenity and comfort, with improved suspension, lighting, air-conditioning, and picture windows; train operation is permitted, allowing higher capacity in the trolley subway. In addition to the car orders, the project also includes a new carhouse at Island and Elmwood, and a new Woodland depot facility to aid in maintaining the new cars on the City Division; new substations on the Red Arrow, and a new power control center, for greater system reliability.
Sites	The first order of City Division cars will operate mainly on subway-surface routes 10, 11, 13, 34, and 36, which serve West Philadelphia; some may be used on surface routes elsewhere in the city. The new Red Arrow cars will run on the Media and Sharon Hill lines.
Schedule	The order will be complete in January, 1982.

Transportation impacts

Person-trip reduction/day	None
Auto user to transit rider trips/day	1839
Auto VMT reduction/day	3254
Gallons of gasoline saved/day	176

Travel time impacts:

Low speed acceleration of the new cars is set at a lower rate than for PCC cars (for passenger comfort), but acceleration at higher speeds is better. Travel time impacts should be minor and would vary by route; there may be a slight speed improvement in the subway and on the suburban lines.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
20.9	15.8	12.9	11	9.7	8.6

Kg/day CO reduction in December 1983:	343.9
" " " " " 1987:	202.8

Kg/day NOx reduction in 1987: 6.3

Regional development impacts	Land use: None cited. Economic: None cited. Social: The deployment of more attractive, comfortable, and reliable equipment should be instrumental in increasing passenger respect for the system and may help reduce incidents of vandalism, a problem on the City Division. Environmental: None cited.	
Capital and operating costs and funding sources	Capital costs, federal	$121,358,000
	Capital costs, state	$ 25,281,000
	Capital costs, local	$ 5,058,000
	Capital costs, total	$151,697,000
	Life of project	30 years
	Annualized capital cost	$ 5,056,567
	Change in annual O&M costs	Not available (1)
	Total annual project cost	Not available
	Notes: (1) Air conditioning may result in increased power demand; maintenance costs should be reduced, as modern cars will replace obsolescent equipment.	
Cost effectiveness	Total annual project cost/kg HC reduced in 1987:	$587,973
Responsibilities	SEPTA will implement the acquisition of the new cars and will be responsible for their operation.	
Commitments	SEPTA will commit to replacing equipment on the subject routes. See Appendix D.	
References	Reference 1, pp. 2-20 to 2-23, 2-29, 2-31, 3-4 to 3-7 Reference 25, p. 7, 19, 41, 43	

PROJECT PA: 3-3

NEW BUSES

Description	This project involves the purchase of 300 Advanced Design Buses (ADBs) in 1981, and 750 additional new standard (35' and 40') city buses from 1982 to 1986. These acquisitions will decrease the mean age of the fleet, and allow a number of worn-out buses built in the 1960s to be retired. The ADBs will have sealed picture windows and full climate control, allowing improved comfort. Although the exact design of the following orders is not finalized, it is certain that they will have ample air-conditioning and represent a styling improvement over the buses they replace.
Sites	The new buses would be used on the City, Frontier and Red Arrow Divisions.
Schedule	The 300 ADBs will arrive in 1982; following that, 150 new standard buses will arrive each year for a five year period.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	24,934
Auto VMT reduction/day	40,278
Gallons of gasoline saved/day	2,175

Travel time impacts:

With more reliabile equipment, a considerable improvement in on-time performance, with reduced headway variability, is anticipated; this will reduce total trip time.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
48.2	56.7	72.3	84.1	96	106.9

Kg/day CO reduction in December 1983:	1,318.7
" " " " " 1987:	2,510.8

Kg/day NOx reduction in 1987:	78.1

Regional development impacts

Land use:

None cited.

Economic:

None cited.

Social:

The deployment of modern, attractive vehicles, with fewer breakdowns, will be instrumental in increasing passenger respect for the system, and may help reduce incidents of vandalism.

Environmental:

None cited.

Capital and operating costs and funding sources	Capital costs, federal	$190,989,600
	Capital costs, state	$ 40,079,244
	Capital costs, local	$ 7,877,156
	Capital costs, total	$238,942,000 (1)
	Life of project	15 years
	Annualized capital cost	$ 15,929,467
	Change in annual O&M costs	Not available (2)
	Total annual project cost	Not available

Notes: (1) Includes impact of inflation on orders after 1982.
(2) Better overall performance than that of the RTS II Advanced Design Buses already on the property is anticipated, with better air-conditioning system design; however, the increased use of air-conditioning should increase fuel costs as compared to the new-look buses replaced. The new equipment should result in reduced maintenance costs.

Cost effectiveness	Total annual project cost/kg HC reduced in 1987: $149,013 (Capital costs only)
Responsibilities	SEPTA will be responsible for procuring the 300 ADBs, and 300 standard buses. PennDOT will coordinate the acquisition of 450 additional standard buses, as part of a cooperative Statewide Bus Pool program. SEPTA will be responsible for operating buses.
Commitments	SEPTA will commit to purchase buses as indicated in schedule. See Appendix D.
References	Ref. 1, pp. 2-20 to 2-23, 2-31, 3-7 to 3-8 Ref. 25, pp. 19,42,44 Ref. 26, pp. 33,70,74

PROJECT PA: 3-4

RAPID TRANSIT AND LIGHT RAIL STATION IMPROVEMENTS

Description	In this project, a number of Broad Street, Market-Frankford, and subway-surface line stations and several related concourse areas would be renovated. The improvements made would include new vandal-proof floor, wall, and ceiling surfaces, renovated platforms, better lighting, improved graphics (signs and maps), benches and other passenger amenities, glass barrier walls, and better waterproofing. Security improvements would also be made, such as elimination of obstacles and underutilized space, provision of stairs with straight runs (without blind turns), and relocation of fare booths for better surveillance. At 8th and Market, the concourse improvements would better integrate the Market-Frankford and PATCO stations; at Columbia Station at Temple University, a landscaped courtyard, continuous with the campus pedestrian mall, would be built into the subway entrance, with good visibility and lighting. Overall, these improvements would enhance safety and security, and present a clean, modern, attractive appearance to users.
Sites	Eight Market-Frankford line stations are included in this project, thirteen stations of the Broad Street Line and eight station on the subway-surface line. The center city concourse and the north and south ends of the 8th Street concourse would also be included.
Schedule	The Columbia Station and 8th Street concourse work should be completed by the end of 1984 while the balance of the Broad Street stations will be completed by the end of 1983; work on the Market-Frankford line and subway-surface improvements would be completed in 1985.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	3372
Auto VMT reduction/day	15,078
Gallons of gasoline saved/day	814

Travel time impacts:

The 8th Street concourse improvements would incorporate an elevator between the Market Street subway and PATCO station levels, allowing a small walking time reduction for about 16% of riders at that point; it is assumed that future walkways from other subway stations to activity centers would also reduce some walking time.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
29.5	34	37.2	34	30.2	27.4

Kg/day CO reduction in December 1983:	489.8
" " " " " 1987:	461.7

Kg/day NOx reduction in 1987: 26.2

Regional development impacts	Land use: The upgrading of rapid transit station facilities may help increase high-density development at some stations, especially along Market Street. Economic: None cited. Social: Brightly-lit, aesthetically-designed stations with improved security will greatly improve the image of the rapid transit system, may reduce incidents of vandalism, and should reduce the fear some riders have of using the system. Environmental: None cited.
Capital and operating costs and funding sources	Capital costs, federal — \$ 18,128,000 Capital costs, state — \$ 3,439,000 Capital costs, local — \$ 1,093,000 Capital costs, total — \$ 22,660,000 Life of project — 30 years Annualized capital cost — \$ 755,000 Annual O&M costs — Not available (1) Total annual project cost — Not available Notes: (1) Some maintenance costs would be reduced, as graffiti-proof surfaces would be used extensively. However, routine maintenance activities may be increased, in keeping with the new image of the system. Increased lighting levels and air-conditioning requirements may result in a small increase in power consumption.
Cost effectiveness	Total annual project cost/kg HC reduced in 1987: \$27,567 (Capital costs only)
Responsibilities	The City of Philadelphia will be responsible for implementing the 8th Street concourse and Columbia station improvements; SEPTA will be responsible for the other improvements mentioned above. SEPTA will be responsible for operation of all of these stations.
Commitments	SEPTA will commit to completing programmed improvements to the Broad St. Line (except Columbia), subway-surface, and Market-Frankford Line stations. The Philadelphia Department of Public Property will commit to completing the Columbia Station and 8th Street Concourse improvements. See Appendix D.
References	Ref. 1, pp. 2-20 to 2-23, 2-33 to 2-34, 3-14 to 3-17 Ref. 24, pp. 42, 45 Ref. 25, pp. 8-9, 20, 42-43, 46

PROJECT PA: 3-5

REGIONWIDE SHELTERS AND SIGNS

Description	In this project, shelters and signs would be installed at heavily used bus stops within the SEPTA service area. The shelter would have a roof and three transparent sides, and would provide information on which bus routes use the bus stop in that location. This project would improve the comfort of surface transit travel during bad weather conditions, and improve bus route identity, eliminating much of the confusion casual users and potential regular riders experience when stops are not well marked.
Sites	250 to 300 localities within the five-county area.
Schedule	This project is already underway, and will be 25% complete by the end of 1981. Work will continue through 1987.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	1729
Auto VMT reduction/day	2793
Gallons of gasoline saved/day	151
Travel time impacts:	None

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
6.8	6.8	7	7.2	7.3	7.4

Kg/day CO reduction in December 1983:	148.8
" " " " " 1987:	174.1

Kg/day NOx reduction in 1987: 5.4

Regional development impacts

Land use:

The image created of more permanent bus stops may impact some location decisions, but only to a very small extent as compared to permanent transit rights-of-way.

Economic:

None cited.

Social:

Improved signing may remove much of the uncertainty felt by users waiting at bus stops, especially in bad neighborhoods.

Environmental:

None cited.

Capital and operating costs and funding sources	Capital costs, federal	$1,575,000
	Capital costs, state	$ 313,000
	Capital costs, local	$ 112,000
	Capital costs, total	$2,000,000
	Life of project	10 years
	Annualized capital cost	$ 200,000
	Change in annual O&M costs	Not available (1)
	Total annual project cost	Not available

Notes: (1) There will be a small annual cost for repair and replacement of damaged shelters and missing signs; there may be a small increase in operating (power) costs where lighting is provided.

Cost effectiveness	Total annual project cost/kg HC reduced in 1987:	$27,027 (Capital costs only)
Responsibilities	SEPTA would probably be responsible for installation and upkeep of signs and shelters.	
Commitments	The DVRPC Board commits to encourage local public officials, working with SEPTA, and others to pursue implementation of this project. (Currently the project is not in the Transportation Improvement program.) See DVRPC's adoption resolution in Appendix D.	
References	Reference 1, pp. 2-20 to 2-23, 2-34, 3-18 Reference 25, p. 23	

PROJECT PA: 3-6

TRANSIT SAFETY AND SECURITY

Description

In this project, all Philadelphia subway and elevated stations would be equipped with closed circuit television (CCTV) cameras. These would be monitored from a centrally-located facility, allowing audio and visual communication with police. Lighting levels at stations would be adjusted to permit good TV picture resolution. A push-button police alarm, with microphones and speakers, would also be installed at stations. Finally, a fire prevention system would be built into the subways, including tunnel lighting, smoke detection devices, and emergency exits. These features would greatly improve passenger safety and security on the rapid transit and subway surface systems.

Sites

The safety and security systems described here would be installed in the Broad Street subway (except for the four stations which are already equipped with CCTV), on the Ridge Street spur, along the Market-Frankford subway-elevated line, and on underground portions of the subway-surface system.

Schedule

Work on this project was begun during 1981, and should be complete in 1982.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	13,212
Auto VMT reduction/day	44,595
Gallons of gasoline saved/day	2,408
Travel time impacts	None

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
-	143.8	113.8	99.1	75.5	79.8

Kg/day CO reduction in December 1983:	2138
" " " " " 1987:	1318

Kg/day NOx reduction in 1987:	77.3

Regional development impacts

Land use:

Increased use of the subway system because of improved safety and security may result in increased high-density development in the vicinity of subway stations.

Economic:

None cited.

Regional development impacts (cont'd)	Social: This project would greatly increase public confidence in the system, by reducing the present high level of crime and vandalism in the subways, and by alleviating fear of fires and other accidents which may stall trains and trolleys between stations underground. Environmental: · None cited.

Capital and operating costs and funding sources

Capital costs, federal	$19,651,000
Capital costs, state	$ 4,095,000
Capital costs, local	$ 818,000
Capital costs, total	$24,564,000
Life of project	30 years
Annualized capital cost	$ 818,800
Change in annual O&M costs	Not available (1)
Total annual project cost	Not available

Notes: (1) Operating costs would include salaries for the camera surveillance team and any additional police personnel, and a small (probably negligible) increase in power to operate the electronic systems. There would be some additional maintenance costs entailed in the operation of cameras and other systems; but some savings would be realized from reduced incidents of vandalism on SEPTA property.

Cost effectiveness	Total annual project cost/kg HC reduced in 1987: $10,648 (Capital costs only)
Responsibilities	The City of Philadelphia would be responsible for the implementation of the security system. SEPTA would be responsible for the installation of the safety system, and for the operation of both systems.
Commitments	Philadelphia Department of Public Property commits to completion of the installation of the CCTV system; SEPTA commits $2.5 million toward completion of its programmed safety improvements. See Appendix D.
References	Ref. 1, pp. 2-34, 2-35, 3-18 to 3-20 Ref. 25, p. 8

PROJECT PA: 3-9

ROUTE 66 TROLLEY LINE EXTENSION

Description	In this project, the Route 66 trackless trolley would be extended 2.3 miles along Knights Road, providing a more direct connection between the rapidly-growing Morrell Park and Parkwood Manor areas and the Frankford Elevated Line. Better access would be provided to the CBD, as well as to shopping areas along Frankford Avenue. Better access would also be provided to the Frankford Hospital Branch and to the Liberty Bell Race Track.
Sites	From the present terminus of the Route 66 trolley at City Line, along Knights Road, to Mechanicsville Road, in Parkwood Manor.
Schedule	The Route 66 extension is expected to be in operation by the summer of 1984. Although work has not yet begun on the overhead along Knights Road, a number of improvements have been made on other portions of Route 66 that will greatly facilitate service on the extension. The single (reversible) express wire south of Cottman, which was in bad need of repair, has been replaced by double express wire (over the median highway lane in both directions), allowing faster operation with fewer dewirements and the ability to deadhead coaches more rapidly. The double express wire has been extended from Cottman to Rhawn, allowing faster express runs to the Knights Road section.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	829
Auto VMT reduction/day	4528 (1)
Gallons of gasoline saved/day	244.5

Travel time impacts:

The new route would provide more convenient service than the Route 20 bus, which presently services the same communities from Academy Road, ½ to 1 mile to the west of Knights Road. In addition to the reduced walking time for many users, better off-peak and weekend schedule frequencies would be provided by Route 66.

Note: (1) An average trip length of 7.1 miles is used, as it is assumed that most new riders already use the Frankford El, and drive their cars to the Frankford and Bridge Park-and-Ride Lot. A few of the new trolley riders may be new el riders also, balanced out by a small number of new local trolley riders to points along Frankford Avenue.

Air quality impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
	13.7	11.2	9.7	8.6	7.8

Kg/day CO reduction in December 1983:	190.5
" " " " " 1987:	122.9

Kg/day NOx reduction in December 1987:	7.8

Regional development impacts	Land use: None cited Economic: None cited Social: The reduced noise and emissions, and superior route identity provided by trackless trolleys would be instrumental in improving rider confidence in the system. Environmental: None cited

Capital and operating costs and funding sources		
	Capital costs, federal	$2,112,000
	Capital costs, state	$ 440,000
	Capital costs, local	$ 88,000
	Capital costs, total	$2,640,000
	Life of project	30 years
	Annualized capital cost	$ 88,000
	Change in annual O&M costs	Not available (1)
	Total annual project cost	Not available

Note: (1) There would be some additional power, maintenance, and labor costs associated with the expansion of trackless trolley service. As compared to buses from which riders may be diverted, or a substitute bus service, trackless trolleys have lower vehicle maintenance costs, but some additional maintenance of way costs.

Cost effectiveness	This is primarily a transportation improvement project. The annual project cost/kg of HC reduced is $11,282 (capital costs only)
Responsibilities	The City would be responsible for the extension of overhead wire and other facility changes along Knights Road, and SEPTA for operating the expanded service.
Commitments	Philadelphia Department of Public Property reaffirms its commitment made in the 1979 SIP to complete the project. See Appendix D.
References	Reference 1 Reference 25, p. 9 Reference 26, p. 56

PROJECT PA: 3-10

NEWTOWN COMMUTER RAIL LINE ELECTRIFICATION

Description	In this project, the Newtown Commuter Rail line would be electrified, with a track connection to the West Trenton Line at Bethayers. This would allow the elimination of the present transfer from Newtown trains to CBD-bound electric trains at Fox Chase. An increase in service is also assumed; sixteen trains per week day are to be scheduled in each direction.
Sites	The section of the Newtown Line to be electrified extends from Bethayers to Newtown in lower Bucks County. The section from Bethayers to Fox Chase, including the Walnut Hill Station, would be abandoned.
Schedule	Presumed to be completed in 1987

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	700
Auto VMT reduction/day	21,600
Gallons of gasoline saved/day	1166

Travel time impacts:

The elimination of the transfer at Fox Chase would save two minutes of travel time on CBD-bound trips.

Air quality impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
					31.3

Kg/day CO reduction in December 1983:	0
" " " " " 1987:	481

Kg/day NOx reduction in December 1987:	41

Regional development impacts

Land use:

None cited

Economic:

None cited

Social:

The provision of a direct trip from the Newtown Branch to Philadelphia would improve the comfort and convenience of travel on the affected corridor.

Environmental:

None cited

Capital and operating costs and funding sources

Capital costs, federal	\$ 9,600,000
Capital costs, state	\$ 2,004,000
Capital costs, local	\$ 396,000
Capital costs, total	\$12,000,000 (1)
Life of project	30 years

Capital and operating costs and funding sources (cont'd)	Annualized capital cost — $ 400,000 Change in annual O&M costs — Not available Total annual project cost — Not available Note: (1) Costs taken from SEPTA's current Capital Program reported as in DVRPC's Transportation Improvement Program. Testimony was received at the Public Hearing that these costs are too high and that the project could be completed, as planned, for less than half of this figure.
Cost effectiveness	This is primarily a transportation improvement project. The annual cost/kg of HC reduced in 1987 would be $12,780 (capital costs only)
Responsibilities	SEPTA would be responsible for the electrification and track connection work and for operation of the service.
Commitments	Local and state matching funds are committed. Although the project is currently in their 1982-1987 Capital Program, SEPTA "is not in a position to make any firm commitment to (this project) at this time." See Appendix D.
References	Reference 1, pp. 2-20 to 2-23 Reference 23, p. 9 Reference 26, p. 83

PROJECT PA: 4-1

REGIONAL RIDESHARING PROGRAM

Description	DVRPC conducts a ridesharing program which promotes carpooling, vanpooling, other paratransit options and a variety of incentives linking the ridesharing mode to other transportation strategies, e.g., public transit passes and park-and-ride arrangements. The marketing program is aimed at three distinct groups of commuters through: (1) employers, (2) community or residential groups, and (3) a public matching service at DVRPC. Promotional activities to spur participation by these groups include: (1) personal contacts; (2) media advertising; (3) distribution of publications, brochures and manuals; (4) employee/group surveys; (5) computer matching of applicants; and (6) other technical assistance such as referrals or advice on more comprehensive transportation programs. The goal of this program is to provide every commuter in the region with as many convenient, cost-effective transportation options as possible.
Sites	Employer program: At all established employers in the five-county DVRPC region. Emphasis will be upon employers or groups of employers with 300 or more employees. However, DVRPC will respond to all requests for ridesharing promotional materials and surveys, regardless of size of company. Community/residential program: At all established community and residential groups in the five-county region. Emphasis will be upon community groups and residential clusters located in areas which generate a substantial number of trips, based on DVRPC county planning area trip generation data. Public program: Through a publicly advertised "car-pool" telephone line, DVRPC responds to all inquiries for commuter ridesharing matches.
Schedule	On-going and continuous through 1987

Transportation impacts (1987)

Person-trip reduction/day	None
Auto driver to auto passenger/day	18,500
Auto VMT reduction/day	175,000
Gallons of gasoline saved/day	9,450

Travel time impacts:

There would be a small increase in in-vehicle time for most users, and some waiting time at the home end of the AM trip.

Air quality impacts	Kg/day HC reduction in July: 1982 1983 1984 1985 1986 1987 – 91 151 194 230 257	
	Kg/day CO reduction in December 1983:	1222
	" " " " " 1987:	3966
	Kg/day NOx reduction in 1987:	329
Regional development impacts	Land use: Less parking space would be required Economic: Reduction in public/private cost for parking facilities, savings in gasoline and auto operation cost to individual, favorable change in insurance rate structures and bank loan arrangements. Social: Reinforces community grass roots networks, improves employer/employee relations, improves transportation options available to commuters, instills conservation values, reduces dependency on individual automobile travel. Environmental: None cited.	
Capital and operating costs and funding sources	Capital costs, federal	None
	Capital costs, state	None
	Capital costs, local	None
	Capital costs, total	None
	Life of project	5 years
	Annualized capital cost	None
	Change in annual O&M costs	
	Total annual project cost	$270,000
Cost effectiveness	Total annual project cost/kg HC reduced each day:	$1050.
Responsibilities	DVRPC and member governments; social, business and community/residential organizations which agree to participate.	
Commitments	DVRPC staff commits to submitting a work program each year through FY 1987 which includes a ridesharing program of sufficient scope to produce the projected emission reduction; PennDOT commits itself to a continuing program of ridesharing activities.	
References	Ref. 7	

PROJECT PA: 6-1

AIRPORT HIGH-SPEED LINE

Description	In this project, a high-speed, premium-service rail line would be operated from Penn Center to the Philadelphia International Airport, using nine rehabilitated Silverliners with comfortable seats and luggage racks. This would replace the SEPTA airport bus service, which is slower and less comfortable. Stops would be made at 30th Street Station, and at two new intermediate stations at the Civic Center and at Eastwick.
Sites	The new line would run from Suburban Station, through 30th Street and along the present Wilmington/Media route to Brill interlocking, and then follow a new route to the airport. The new line would also serve the proposed Civic Center (at Convention Avenue) and Eastwick Stations at 70 Street.
Schedule	The line is expected to be completed in late 1983 and in full operation by January, 1984.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	3,612 (1)
Auto VMT reduction/day	29,989
Gallons of gasoline saved/day	1619

Travel time impacts:

The new line would provide a faster route to the airport, shortening a 40-minute bus ride to a 20-minute train trip during peak hours (off-peak, the bus trip takes 25 minutes, so the savings would be five minutes). Headways would be reduced from 30 minutes to 20 minutes; and schedules would be unaffected by variations due to weather or traffic congestion which may cause unexpected delays in the bus service. The Civic Center Station would reduce walking time between 30th Street Station and the University area.

Notes: (1) Diverted auto user trips include taxi rides for purposes of this analysis.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
		55.5	51.4	47.4	43.7

Kg/day CO reduction in December 1983:	-0-
" " " " " 1987:	672.5

Kg/day NOx reduction in December 1987: 56.8

Regional development impacts

Land use:

Present airport roads and parking facilities are expected to be overloaded by 1985; the new line could alleviate

Regional development impacts (cont'd)	the need to expand other airport facilities which would require more land area. The Eastwick station could have a minor impact on the area by increasing high-density development and other activity. Economic: The airport line would provide a cheaper alternative than taxi and limousine service for some airport users; and would be cheaper than long and short term parking. Social: If implemented, the airport line would make Philadelphia the second city in the U.S. (after Cleveland) with a direct airport rapid transit connection (with no change to a shuttle bus at the airport). This would help to improve the city's image. Environmental: Diversion of future airport traffic to the rail line may lessen the demand for increased highway access to the airport, reducing damage to the wetlands nearby.

Capital and operating costs and funding sources

Capital costs, federal	\$ 91,528,000
Capital costs, state	\$ 19,079,000
Capital costs, local	\$ 3,815,000
Capital costs, total	\$114,472,000
Life of project	30 years
Annualized capital cost	\$ 3,815,733
Change in annual O&M costs	\$ 1,741,907 (1)
Total annual project cost	\$ 5,557,640

Notes: (1) The original 1971 Airport Line figure represented in 1981 dollars. It may be reduced by curtailing airport bus service.

Cost effectiveness	Total annual project cost/kg HC reduced in 1987: \$127,177. This is primarily a transportation project, rather than an air quality project.
Responsibilities	The City of Philadelphia will be responsible for construction of the Airport High-Speed Line; SEPTA will be responsible for operations.
Commitments	Philadelphia Department of Public Property reaffirms its commitment made in the 1979 SIP to complete the Airport High-Speed Line. In addition, the Department now commits to completion of the two intermediate stations. See Appendix D.
References	Ref. 1, pp. 2-19 to 2-23, 2-33, 3-13 to 3-14 Ref. 17, pp. 5-6 Ref. 25, pp. 20, 22, 25 Ref. 26, p. 67

PROJECT PA: 6-2

CENTER CITY COMMUTER CONNECTION

Description	In this project, a four-track tunnel would link the former Penn-Central and Reading commuter rail operations, with a new Market Street East Station. This would provide greater track capacity, and through routing of trains, with wider CBD distribution. In addition to tunnel and station construction a number of related infrastructure improvements will be made. Passenger signing and information would be improved at the extant 30th Street and Suburban stations, with TV surveillance at all CBD commuter rail stations. Finally, a sheltered connection would be provided to the 11th Street Market-Frankford line station; the latter would be refurbished, with new station interior surfaces, an improved pedestrian bridge, new lighting, graphics, and glass fence barriers.
Sites	The new tunnel section would run from 9th Street to the existing Suburban Station at 16th Street; the new station will extend from 10th to 12th Street. The operation would also impact 30th Street Station, and allow through trips between the northern and western suburbs.
Schedule	The Center City Commuter Connection would become operational in 1984.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	8,419
Auto VMT reduction/day	109,417
Gallons of gasoline saved/day	5,909

Travel time impacts:

The CCCC would provide greater convenience for commuters, with reduced walking time for some and elimination of a transfer to the subway (reducing waiting time) for others. The center door operation, and high platform loading at Reading Terminal will reduce loading and unloading time.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
	5.6	4.6	197.0	176.3	159.0

Kg/day CO reduction in December 1983:	78.2
" " " " " 1987:	2,446

Kg/day NOx reduction in 1987: 207

Regional development impacts

Land use:

A major aspect of the project would be joint development of transit and commercial/office space, including Gallery II, an extension of the existing shopping mall, Market East office space, and retail space beneath 10th and 11th streets, between the center city tunnel and the 11th Street subway station.

Regional development impacts (cont'd)

Economic:

This project is expected to stabilize or reverse the declining retail strength of center city, providing more retail and office jobs downtown.

Social:

The CCCC improvements, with improved station attractiveness and security, would go a long way towards improving the public image of the high speed rail network serving the CBD, and would greatly improve the city as a place in which to live, work, shop, or visit.

Environmental:

None cited.

Capital and operating costs and funding sources

Capital costs, federal	$373,969,000
Capital costs, state	$ 72,343,000
Capital costs, local	$ 15,586,000
Capital costs, total	$461,894,000 (1)
Life of project	30 years
Annualized capital cost	$ 15,396,467
Change in annual O&M costs	- 4,631,040
Total annual project cost	$ 10,769,427 (2)

Notes: (1) Includes the 1-year informational program
(2) The CCCC eliminates stub-end operation and various attendant labor-intensive maintenance duties which must presently be performed at Suburban Station and Reading Terminal. The through-routing of trains should allow more productive use of equipment and train crews, reducing operating costs.

Cost effectiveness

Total annual project cost/kg HC reduced in 1987: $67,707. This is primarily a transportation project, not an air quality project.

Responsibilities

The City of Philadelphia would be responsible for the construction of the Center City Commuter Connection (the new tunnel and station), and the Market Street East Intermodal Connection and Joint Development. SEPTA would be responsible for facilities coordination, for car modifications, and for the public information program.

Commitments

Philadelphia Department of Public Property reaffirms its commitment made in the 1979 SIP to complete the project. See Appendix D.

References

Ref. 1, pp. 2-31, 2-32 and 3-9 to 3-13
Ref. 16, pp. 31-33
Ref. 24, pp. 21,45
Ref. 25, pp. 10, 13-14, 20, 44
Ref. 26, pp. 48-49,54

PROJECT PA 7-1

CENTER CITY PARKING POLICIES

Description

In this project, Philadelphia will implement several complementary parking policies which will tend to reduce commuter trips to Center City. The first of these is to raise the parking meter rate to 75¢ an hour from 25¢ in order to reduce "meter-feeding" by commuters and thereby encouraging a number of them to use transit instead. Also, 2500 new meters will be installed in Center and University Cities and an increase in enforcement will further reduce commuter use of on-street parking. An increase in the number of tickets issued, a more effective towing program, use of "Denver Boot" for scofflaws and improved computer processing of tickets are parts of the enforcement program. These measures will make on-street parking for readily available to the short-term parker. Although more trip makers may be encouraged to drive downtown, these trips will be later in the day and will not contribute significantly to ozone formation or CO hotspots.

Sites

Center City (river to river and South to Vine) and University City, Philadelphia

Schedule

All components assumed to be in effect by summer, 1983. $3 million has been budgeted for improved on-street enforcement beginning July 1, 1982.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	521
Auto VMT reduction/day	3,689
Gallons of gasoline saved/day	199

Travel time impacts:

Less time will be consumed in cruising while searching for on-street parking. Slightly less congestion in CBD due to fewer auto commuters and enforcement of parking regulations.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
-	11.2	9.1	7.9	7.0	6.3

Kg/day CO reduction in December 1983: 155
" " " " " 1987: 100

Kg/day NOx reduction in December 1987: 6.3

Regional development impacts

Land use:

The availability of inexpensive short-term parking in Center City will enhance its attractiveness for shopping

Economic:

City revenues will increase

Regional development impacts (cont'd)	Social: None cited Environmental: None cited

Capital and operating costs and funding sources		
	Capital costs, federal	-
	Capital costs, state	-
	Capital costs, local	$ 2,250,000 (1)
	Capital costs, total	$ 2,250,000 (1)
	Life of project	15 years
	Annualized capital cost	$ 150,000
	Change in O&M cost	$-13,000,000 (2)
	Total annual project cost	$-12,850,000

Notes: (1) Approximate cost of purchase and installation of 2500 new meters and adjustment for new rates to all existing meters
(2) Approximation. Assumes $12M in added revenues from increased issuance and collection of parking tickets and $3M in costs of enforcement. Also assumes an increase of $4M in parking meter revenue.

Cost effectiveness	The project is essentially free because revenues are greater than costs.
Responsibilities	The City of Philadelphia is responsible for all aspects of the project, the Department of Streets for installation of meter, the Department of Revenue for collection of parking fees and the Police Department for enforcement.
Commitments	A commitment is made for the City Administration to all aspects of the project. See Appendix D.
References	Ref. 8

PROJECT PA 11-1

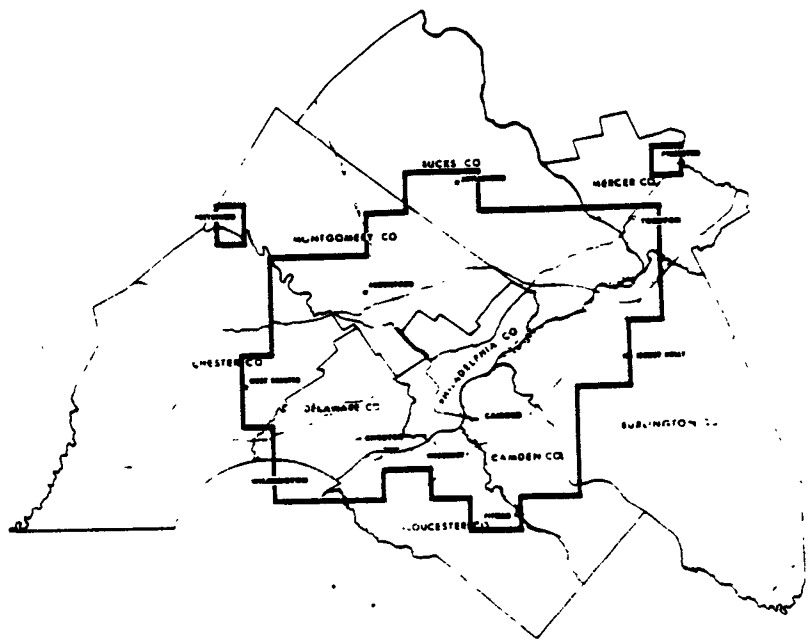
PREFERRED BICYCLE ROUTE MAP

Description

This project includes the preparation and distribution of 10,000 copies of a map of Preferred Bicycle Routes for the urban portion of the Delaware Valley region. It is assumed that 7200 of the maps will be sold to the residents of Pennsylvania. The availability of the map, which is designed for field use by bicyclists, will facilitate bicycle travel, especially for persons who would not use a bicycle because they are not familiar with alternative routes. The availability of this map will increase commuter utiliziation of the bicycle mode and may also enhance recreational use. Impacts will be greater in summer months when weather for bicycle travel is best and when ozone violations are most frequent.

Sites

The index map below identifies the area covered by the map. Mo of the urbanized portion of the region is included.



Schedule

The map will be completed and published in summer 1982.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to bicycle user trips/day	6,100
Auto VMT reduction/day	12,200
Gallons of gasoline saved/day	660

Travel time impacts:

Travel time for those switching from auto to bicycle will be increased overall. Those whose trips are in congested locations may experience a reduction in travel time.

Emissions impacts	Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
16	24	29	34	35	32

Kg/day CO reduction in December 1983:	523
" " " " " 1987:	762
Kg/day NOx reduction in 1987:	24

Regional development impacts

Land use:
None cited
Economic:
Operational cost savings for bicyclists
Social:
Improved physical fitness for bicyclists
Environmental:
Noise reduction associated with fewer auto trips

Capital and operating costs and funding sources

Capital costs, federal	$12,000 (1)
Capital costs, state	$ -0-
Capital costs, private	$ 5,000 (1)
Capital costs, total	$17,000 (1)
Life of project	5 years
Annualized capital cost	$ 3,400
Change in annual O&M costs	—
Total annual project cost	$ 3,400

Notes: (1) Costs are for 10,000 initial copies. A grant from Michelin Tire will permit printing on no-tear paper, enhancing the maps usable life. A fee for the map will generate revenue for distribution, updating and reprinting.

Cost effectiveness

This project produces a kg of HC reduction (each fair weather day in 1987) for each $77 invested. This measure is highly cost effective due to the relatively low cost and high rate of emission reduction. Reductions are high because each auto trip is replaced by a bicycle trip with zero emissions; all replaced trips are "cold starts."

Responsibilities

The Greater Philadelphia Bicycle Coalition will be responsible for printing and disseminating the map and will be responsible for any revision and republication.

Commitments

Greater Philadelphia Bicycle Coalition commits itself to the above responsibilities. See Appendix D.

References

Ref. 10

PROJECT PA 11-2

OTHER BICYCLE MEASURES

Description	The purpose of this project is to initiate capital improvements to enhance bicycling conditions. The project is limited to those improvements already programmed and where they are thought to be significant in the number of persons who may be induced to use bicycles to commute to jobs. The only such improvement for which a commitment could be obtained at this time is a new phase of the Philadelphia-FHWA Transit Station Bicycle Locker program. In the program, some of the 292 lockers the City has installed at commuter stations will be relocted to places where, it is hoped, they will be better utilized. DVRPC will add other appropriate improvements as commitments are made.
Sites	Throughout the Pennsylvania portion of the region, but primarily within the city.
Schedule	The locker replacement program will be completed before the end of 1983.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	140
Auto VMT reduction/day	280
Gallons of gasoline saved/day	15

Travel time impacts:

Travel time increase (in most cases) for those switching from auto to bicycle

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
-	-	0.7	0.6	0.5	0.5

Kg/day CO reduction in December 1983:	-
" " " " " 1987:	7.6
Kg/day NOx reduction in December 1987:	0.5

Regional development impacts

Land use:

None cited

Economic:

May stimulate demand for bicycles and further lockers. May tend to reduce transit revenues.

Social:

Encourages good health through exercise

Environmental:

Bicycling is quiter than automobile travel

Capital and operating costs and funding sources	Capital costs, federal	-
	Capital costs, state	-
	Capital costs, local	-
	Capital costs, total	- (1)
	Life of project	-
	Annualized capital cost	-
	Change in O&M cost	- (2)
	Total annual project cost	-
	Notes: (1) Public costs are limited to administrative costs of contracting with vendor (2) No continuing public cost; lockers are maintained by private vendor.	
Cost effectiveness	Total annual cost per kg/day emission reduction: Not estimated	
Responsibilities	The City of Philadelphia Department of Public Property is responsible for contracting with a vendor who will relocate, lease and maintain the lockers.	
Commitments	The Department of Public Property is committed to the above responsibilities. See Appendix D.	
References	None	

PROJECT PA 19-1

EDUCATIONAL CAMPAIGN TO REDUCE AUTOMOBILE EMISSIONS

Description	A campaign to raise awareness of efficient automobile driving techniques, resulting in appreciable reductions in extended idling and cold starts, and in better trip planning. The campaign can be carried out in two phases, simultaneously or staggered. The first would emphasize driver education and direct mail advertising and promotion through automobile retailers; a second phase would include a media campaign featuring prominent spokespersons in television, radio and magazine public service announcements, and interviews. Effectiveness of the campaign is dependent upon cooperation of public. It is estimated that 10% of all drivers contacted will adopt efficient driving techniques.
Sites	Phase 1: Driving courses administered regionwide (in both the Pennsylvania and New Jersey portions of the DVRPC region), retail promotion regionwide, direct mail and other promotion concentrated in areas with high trip incidence and where households with two or more cars are prevalent. Phase 2: Media campaign carried out regionwide, but targeted to specific market segments to achieve wide exposure of efficient driving objectives.
Schedule	To be carried out 1984 through 1987.

Transportation impacts (1987)

Person-trip reduction/day	20,640
Auto driver to auto passenger trips/day	2,080
Auto trip reduction/day	15,876
VMT reduction/day	119,630
Gallons of gasoline saved/day	6,464
Travel time impacts:	None

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
0	0	61	105	140	167

Kg/day CO reduction in December 1983:	0
" " " " 1987:	2,560
Kg/day NOx reduction in 1987:	218

Regional development impacts

Land use:

Emphasis on efficient trip planning may lead to different traffic distribution patterns in targeted areas.

Economic:

None cited.

Regional development impacts (cont'd)	Social: Appeals to civic and personal values; advances greater public awareness of need for energy conservation; provides for adult educational opportunities; and may promote personal interactions among groups of people seeking solutions to shared problems. Environmental: None cited
Capital and operating costs and funding sources	Capital costs, federal — None Capital costs, state — None Capital costs, local — None Capital costs, total — None Life of project — 5 years Annualized capital cost — None Change in annual O&M costs — $96,000 (1)(2) Total annual project cost — $96,000 Notes: (1) Cost for both states (2) One third of costs assumed to be borne by private sources.
Cost effectiveness	Total annual project cost/kg HC reduced: $353
Responsibilities	DVRPC and member governments to define, develop and coordinate. Campaign carried out with assistance by and involvement of private sector.
Commitments	DVRPC staff commits to the preparation of a detailed work program to be submitted as part of the FY 1984 Integrated Work Program; the DVRPC Board and PennDOT commits to considering the establishment of such a program. (Interest expressed by Keyston Triple A to be involved with driver education portion of campaign.)
References	Ref. 11

PROJECT NJ: 3-3

NEW BUSES

Description	This project includes the purchase of 16 short-haul transit buses for local use and 103 new long-haul commuter buses. The short-haul buses will be Grumman-Flexible 870 Advanced Design Buses, with improved styling, sealed windows, and complete climate control for improved comfort. Although the design of the long-haul buses is not finalized, it is assumed that they will have comfortable seating and air conditioning for greater passenger amenity. As the majority of the long-haul buses are required for sea shore service on weekends during summer months, approximately 80 will be available for weekday service on local and commuter routes.
Sites	The 16 ADBs will be placed in service on local bus routes, as follows:
	Route A Camden-Audubon-Westmont (PATCO)-Cherry Hill Mall
	Route C Cramer Hill-Camden-Pennsauken
	Route E Camden-Ferry Avenue (PATCO)
	Route H (old route HI) Camden-Gloucester-Bellmawr Industrial Park
	Route V Camden-Gloucester-Haddonfield (PATCO)-Moorestown Mall
	The long-haul buses would be used in Philadelphia commuter service and on express, limited, and local shore runs through the four-county area, affecting service along the White and Black Horse Pikes, and to Cherry Hill, Moorestown, Mount Holly, Deptford Mall, Blackwood, etc.
Schedule	The short-haul buses will arrive early in 1983. The long-haul buses will be delivered during 1983.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	161
Auto VMT reduction/day	1610
Gallons of gasoline saved/day	74.1

Travel time impacts:

With new, more reliable equipment, some improvement in on-time performance, with reduced headway variability, is anticipated; this should allow a small reduction in total trip time.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
7.3	47.8	42.8	38.3	34.2	30.7

Emissions impacts (Cont'd)	Kg/day CO reduction in December 1983:	141.7
	" " " " " 1987:	92.4
	Kg/day NOx reduction in 1987:	90.1

Regional development impacts	Land use: None cited Economic: None cited Social: The introduction of modern, attractive vehicles will be instrumental in improving the public image of the system. Environmental: None cited

Capital and operating costs and funding sources	Capital costs, federal	$15,504,000
	Capital costs, state	$ 3,296,000
	Capital costs, local	- 0 -
	Capital costs, total	$18,800,000
	Life of project	15 years
	Annualized capital cost	$ 1,253,333
	Change in annual O&M costs	-($ 1,408,960) (1)
	Total annual project cost	-($ 155,627)

Notes: (1) For the initial order of short-range ADBs, the use of full climate-control should increase fuel costs as compared to "New Look" buses. However, the newness of the vehicles will allow a considerable reduction in maintenance costs. Overall, the new equipment will allow reduced operating and maintenance costs.

Cost effectiveness	This is primarily a transportation improvement project. As the project results in a net savings, there is no cost in generating new ridership, and the emission reduction is essentially free.
Responsibilities	NJTC will be responsible for the statewide bus pool projects in which these vehicle acquisitions are included. NJ Transit will be responsible for operating the buses in the DVRPC region.
Commitments	New Jersey Transit Corporation commits to the program as indicated above. See Appendix D.
References	Reference 2, pp. 98-100 Reference 25, pp. 14, 47

PROJECT NJ: 3-4

REHABILITATED BUSES

Description	In this project, 525 buses throughout the state would be rehabilitated. Approximately 108 of these would be in the Southern Division, of which 65 would received new engines. This project would greatly improve the mechanical reliability and aesthetics of the affected vehicles.
Sites	90% of the rehabilitated buses would operate on various routes in Camden, Burlington, and Gloucester counties, with a few of the remaining buses providing service along routes 9, 9A, 9B, and 9C which extend into Mercer County.
Schedule	This project would span a three-year period, from 1982 to 1984.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	322
Auto VMT reduction/day	1610
Gallons of gasoline saved/day	75.1

Travel time impacts:

With more reliabile equipment, some improvement in on-time performance, with reduced headway variability, is anticipated; this should allow a small reduction in total trip time.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
10.4	19.2	26.5	24.2	22.3	19.9

Kg/day CO reduction in December 1983:	62.6
" " " " " 1987:	65.5

Kg/day NOx reduction in 1987: 57.9

Regional development impacts

Land use:

None cited

Economic:

None cited

Social:

The visual appearance of the rehabilitated vehicles, which will look practically new, will be instrumental in improving the public image of the system.

Environmental:

None cited.

Capital and operating costs and funding sources	Capital costs, federal	$3,846,717
	Capital costs, state	$ 555,568
	Capital costs, local	$ - 0 -
	Capital costs, total	$4,402,285
	Life of project	7 years
	Annualized capital cost	$ 628,898
	Change in annual O&M costs	-($ 421,200) (1)
	Total annual project cost	$ 207,698

Notes: (1) Practically all of the savings will result from the lower maintenance costs of re-engined and thoroughly overhauled buses.

Cost effectiveness	This is primarily a transportation improvement project. Cost for the project amounts to $10,437 per kg of HC emissions reduced as a result of the increased transit ridership.
Responsibilities	NJ Transit would be responsible for rehabilitating the buses and operating them in the DVRPC region.
Commitments	New Jersey Transit Corporation commits to the program indicated above. See Appendix D.
References	Reference 2, pp. 101-102

PROJECT NJ: 3-5

TWO WAY BUS RADIOS

Description

In this project, all buses in the NJ Transit fleet would be equipped with two-way radios. In the Southern Division, this would include 75 local transit buses and 238 commuter buses. This project would allow remote monitoring of on-time performance, traffic conditions, and vehicle breakdowns, and improved security, with an alarm system activated by the driver's foot.

Sites

All Southern Division routes in the four-county area.

Schedule

The short-haul buses would be equipped with radios in 1983, while the long-haul buses would be so equipped in 1984.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	1905
Auto VMT reduction/day	8083
Gallons of gasoline saved/day	377.2

Travel time impacts:

This project would allow some reductions in travel time delays, allowing transit vehicles to be re-routed around accident areas, etc., and would facilitate long-term scheduling improvements, to further reduce delays.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
0	1.8	15.6	13.7	12.0	10.7

Kg/day CO reduction in December 1983:	16.1
" " " " " 1987:	105.3

Kg/day NOx reduction in December 1987:	22.4

Regional development impacts

Land use:

None cited.

Economic:

None cited.

Social:

This project would improve the public perception of transit reliability and security as well as reduce the actual incidence of crime on the buses.

Environmental:

None cited.

Capital and operating costs and funding sources	Capital costs, federal	$4,124,000
	Capital costs, state	$1,031,000
	Capital costs, local	$ - 0 -
	Capital costs, total	$5,155,000
	Life of project	15 years
	Annualized capital cost	$ 343,667
	Change in annual O&M costs	$ 110,000 (1)
	Total annual project cost	$ 453,667

Notes: (1) O&M costs would include $100,000 in salaries for dispatchers and maintenance men, and $10,000 for materials.

Cost effectiveness	This is primarily a transportation improvement project. There is an air quality benefit whose costs amount to $42,399 per kg of HC emissions reduced.
Responsibilities	NJ Transit would be responsible for procuring and installing the radio system, and for operating the buses so equipped.
Commitments	New Jersey Transit Corporation commits to the project as indicated above. See Appendix D.
References	Reference 2, pp. 96-97

PROJECT NJ 3-6

IMPROVED ON-TIME PERFORMANCE

Description	In this project, steps would be taken to improve on-time performance of the NJ Transit bus system, and to inform the public of the progress made in this area. NJTC interest is in improving on-street supervision through better training, better equipment and greater numbers of supervisors (providing resources permit). Supervisors would be provided with two-way radios to enable reporting of delays (See Project NJ 3-5). Supervisors would keep detailed records of the performance of each trip, and document the progress made to reduce deviations from published schedules.
Sites	All NJ Transit local and commuter bus routes in the four-county area would be affected.
Schedule	The rescheduling effort and publicity campaign would be carried on over a three-year period, from 1982 to 1984, with the most intensive effort focussed on the first year.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	4341
Auto VMT reduction/day	18,365
Gallons of gasoline saved/day	857

Travel time impacts:

This project would allow some reductions in travel time delays resulting from buses not being able to adhere to existing schedules due to traffic congestion.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
14.9	26.4	35.4	31.1	27.4	24.2

Kg/day CO reduction in December 1983:	233.9
" " " " " 1987:	240

Kg/day NOx reduction in 1987:	50.9

Regional development impacts

Land use:

None cited.

Economic:

None cited.

Social:

The publicity campaign would greatly enhance the system's image as a reliable form of transportation.

Environmental:

None cited.

Capital and operating costs and funding sources	Capital costs, federal	$ - 0 -
	Capital costs, state	$ 5,000
	Capital costs, local	$ - 0 -
	Capital costs, total	$ 5,000 (1)
	First year additional O&M costs	$300,000 (2)
	Project life	3 years
	Annualized capital and other start-up costs	$101,667
	Change in regular annual O&M costs	$263,333 (3)
	Total annual project cost	$365,000

Notes: (1) For car radios
(2) Includes extra media campaign expenses.
(3) Includes $100,000/year media campaign, $160,000/year for supervisors, and a total of $10,000 spread over a three year period for schedule monitoring and revision.

Cost effectiveness	This is primarily a transportation improvement project. There is an air quality benefit whose costs amount to $15,083 per kg of HC emissions reduced.
Responsibilities	NJ Transit would be responsible for the monitoring and re-rescheduling effort and for the media campaign.
Commitments	NJTC is committed to carry out the program
References	Reference 2, pp. 124-127

PROJECT NJ: 3-7

EXTENSION OF NJT ROUTE IN PHILADELPHIA

Description	In this project, the circulation route used by most NJ Transit commuter buses in Center City Philadelphia would be extended across town to provide greater area coverage. Additional buses would be needed if existing headways are to be maintained. NJTC will study alternative routings during the next year. All routes which enter Philadelphia will be studied.
Sites	In order to calculate impacts, the consultant assumed that the selected route extension would begin at City Hall, then westbound along J.F. Kennedy Boulevard to 30th Street Station, eastbound along Market Street, and northbound on 18th Street to Race Street where it would resume the present route to the Ben Franklin Bridge. The bus routes affected would be any which cross the Ben Branklin Bridge.
Schedule	The route extensions, if recommended, would be implemented some time after the study is completed in July, 1983

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	189
Auto VMT reduction/day	1984
Gallons of gasoline saved/day	93

Travel time impacts:

There would be a decrease in walking time or transfer time for New Jersey bus riders bound for Philadelphia points west of City Hall.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
-	-	3.6	3.1	2.7	2.4

Kg/day CO reduction in December 1983:	-
" " " " " 1987:	25.1
Kg/day NOx reduction in 1987:	4.2

Regional development impacts

Land use:
None cited.

Economic:
None cited.

Social:
None cited.

Environmental:
None cited.

Capital and operating costs and funding sources	Capital costs, federal	\$ - 0 -
	Capital costs, state	\$ - 0 -
	Capital costs, local	\$ - 0 -
	Capital costs, total	\$ - 0 - (1)
	Life of project	10 years
	Annualized capital cost	\$ - 0 -
	Change in annual O&M costs	\$250,000 (2)
	Total annual project cost	\$250,000

Note: (1) As some extra buses purchased for weekend shore runs would be available during weekdays for commuter service, it is anticipated that no additional equipment would need to be purchased.
(2) For the sample route described under "sites."

Cost effectiveness: This is primarily a transportation improvement project. There is an air quality benefit whose costs amount to \$104,167 per kg of HC emissions reduced.

Responsibilities: NJ Transit would be responsible for the expansion of commuter bus service in Philadelphia.

Commitments: NJTC is committed to carrying out the study of routings. See appendix D.

References: Reference 2, pp. 130-131

PROJECT NJ: 3-8

RATIONALIZATION OF NJT FARE STRUCTURE

Description	In this project, the rather confusing fare zone structure presently in use on New Jersey bus routes would be replaced with a fare structure that is much easier to understand. In the proposed new zone configuration, 70¢ would be charged for the first zone, with a 20¢ zone charge for each additional zone for trips within New Jersey or 35¢ zone charge for interstate trips. An additional surcharge of 20¢ would be charged for trips into Philadelphia. (Philadelphia to Camden fare will be 90¢.)
Sites	All NJ Transit routes in the New Jersey DVRPC region, including Philadelphia commuter routes.
Schedule	The new zone structure is to go into effect in July, 1982.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	917
Auto VMT reduction/day	3877
Gallons of gasoline saved/day	180.9
Travel time impacts:	None

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
9.4	8.4	7.5	6.6	5.8	5.1

Kg/day CO reduction in December 1983:	74.1
" " " " " 1987:	50.5
Kg/day NOx reduction in 1987:	10.7

Regional development impacts

Land use:
None cited.

Economic:
None cited.

Social:
The new zone fare structure should remove much of the apprehension many present and potential users may feel about using the system.

Environmental:
None cited.

Capital and operating costs and funding sources

Capital costs, federal	$ - 0 -
Capital costs, state	$ - 0 -
Capital costs, local	$ - 0 -
Capital costs, total	$ - 0 -
First year additional O&M costs	$150,000 (1)
Life of project	10 years
Annualized start-up costs	$ 15,000
Change in annual O& M costs	$ - 0 -
Total annual project cost	$ 15,000

	Note: (1) Costs entailed in publicizing the service, capitalized over a 10-year period and discounted at 15%.
Cost effectiveness	This is primarily a transportation improvement project. There is an air quality benefit whose costs amount to $2,941 per kg of HC emissions reduced.
Responsibilities	NJ Transit would be responsible for the zone fare restructuring and for the publicity program.
Commitments	The fare changes have been approved by the NJTC Board. See commitment in Appendix D.
References	Reference 2, pp. 128-129

PROJECT NJ: 3-9

PARK AND RIDE BUS SERVICE

Description	Eight routes serving park and ride lots at thirteen locations which would provide service between New Jersey suburbs and Philadelphia will be examined by NJTC. Users could park their cars at lots or be dropped off and then board buses (or form carpools or vanpools).
Sites	The sites to be studied include: (1) Jefferson Ward (Delran) and Willingboro Plaza to Philadelphia via US 130, Betsy Ross Bridge and I-95 (2) Cinnaminson Shopping Center to Philadelphia via US 130, Betsy Ross Bridge and I-95 (3) Fairgrounds (Mt. Holly), Lumberton Plaza and Moorestown Mall to Philadelphia via NJ Route 38 (4) Marlton Plaza to Philadelphia via NJ Route 70 (5) Williamstown Center to Philadelphia via NJ Route 47 and I-676 (6) College Town (Glassboro) to Philadelphia via NJ Route 47 and I-676 (7) Toll House Plaza (Mantua) and Acme Shopping Center (Woodbury) to Philadelphia via NJ Route 45 and I-676 (8) Paulsboro Center and Deptford Mall to Philadelphia via NJ Routes 44, 534, 544 and 42 and I-676
Schedule	It is presumed that 25% of the parking places will be made available in each year 1983 through 1986

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	2,316
Auto VMT reduction/day	26,400
Gallons of gasoline saved/day	1,425

Travel time impacts:

Increased travel time for users, including waiting time. Impacts negligible for non-users.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
-	13.3	21.4	27.0	32.1	28.3

Kg/day CO reduction in December 1983:	169
" " " " " 1987:	350

Kg/day NOx reduction in December 1987: 56.8

Regional development impacts

Land use:

Less CBD parking space required, freeing urban land for more productive uses

Economic:

Likely additional subsidies required for transit service. Increases in sales at participating shopping center

Regional development impacts (cont'd)	Social: Reduced VMT will mean fewer accidents Environmental: None cited
Capital and operating costs and funding sources	Capital costs, federal $4,300,000 Capital costs, state $1,100,000 Capital costs, local - Capital costs, total $5,400,000 (1) Life of project 15 years Annualized capital cost $ 360,000 Change in annual O&M costs $ 950,000 (2) Total annual project cost $1,310,000 Notes: (1) Includes $1,200,000 for park and ride lot improvements and $4,200,000 for new buses. New buses may be unnecessary if some buses for weekend shore service are available on weekdays. (2) Includes $50,000 for maintenance of lots and $900,000 for O&M of bus service.
Cost effectiveness	Total annual project cost/kg HC reduced in 1987: $46,000
Responsibilities	New Jersey Transit would be responsible for obtaining agreement for the use of facilities for modifications to the lots, and for operation of bus services. DVRPC will assist in further analysis of routes.
Commitments	NJTC will examine the feasibility of initiating park and ride service at these facilities. See Appendix D. Because of the uncertainty of implementation, no commitment is made to find substitute projects if these are not carried out. Note that no discussions have yet taken place with facility owners
References	Ref. 4, pp 18-31

PROJECT NJ 3-10

WOODBURY AND TURNERSVILLE PARK AND RIDE

Description	Park and ride lots will be established at two shopping malls in Gloucester County. Together, these lots will provide approximately 600 parking spaces. The lots will be served by existing bus service and in the case of Woodbury, a new morning and evening peak period non-stop express trip will be added. New Jersey Transit will also evaluate the feasibility of providing additional express service on these two routes. Joint-use lease agreements will be sought with the owners of the two lots, and shelters and signs will be erected.
Sites	At the Woodbury Plaza at Routes 534 and 47 in Deptford and at the Jefferson Ward store on Route 42 at Turnersville (Washington Township)
Schedule	January 1983 - June 1983

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	149
Auto VMT reduction/day	2100
Gallons of gasoline saved/day	113

Travel time impacts:

Increased travel time for user, including waiting time. Impacts negligible for non-users.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
3.7	3.4	3.0	2.7	2.4	2.2

Kg/day CO reduction in December 1983:	35
" " " " " 1987:	26

Kg/day NOx reduction in December 1987:	2.1

Regional development impacts

Land use:

Less CBD parking space required, freeing urban land for more productive uses.

Economic:

Likely additional subsidies required for transit service.
Increased in sales at participating shopping centers.

Social:

Reduced VMT will mean fewer accidents

Environmental:

None cited

Capital and operating costs and funding sources	Capital costs, federal	$ 80,000 (?)
	Capital costs, state	$ 20,000 (?)
	Capital costs, local	-
	Capital costs, total	$100,000 (1)
	Life of project	15 years
	Annualized capital cost	$ 6,700
	Change in O&M cost	$ 33,500 (2)
	Total annual project cost	$ 40,200

Notes: (1) Preliminary estimate for all park and ride lot improvements (accessibility improvements, signing, lighting, marking, shelters). It is assumed that a bus will be available for the new trip.
(2) Includes $3,500 for maintenance of lot and $30,000 for operation of new trip.

Cost effectiveness	Total annual project cost/kg HC reduced daily in 1987:	$16,750

Responsibilities

New Jersey Transit will be responsible for assisting or initiating attempts to obtain formal agreements with owners; programming of capital facility improvement and funding of shelters, signs and other amenities; and operation of one new morning and evening peak period non-stop express trip between Woodbury Plaza and Philadelphia.

Commitments

New Jersey Transit will commit to those items listed above under responsibilities. S ee Appendix D.

References

Reference 4, pp. 18-31

PROJECT NJ 4-4

STATEWIDE RIDESHARING PROGRAM

Description	The New Jersey Office of Ridesharing encourages the use of ridesharing (through promotion of public transit, buspooling, vanpooling and carpooling) by commuters. The office advocates employer-based programs by means of 2 or 3 day seminars, executive briefings and free employee matching services. Also, pilot area-based programs will be established for smaller employers, and a pilot project will be established in northern New Jersey to test the brokerage concept, which may, if successful, be extended to this area.
Sites	At all established employers in the four-county DVRPC region. Emphasis will be first upon those employers with more than 500 employees. (These firms account for more than half the employees.) The program will continue with other firms in descending order of size.
Schedule	Ongoing and continuous through 1987.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto driver to auto passenger trips/day	13,182
Auto VMT reduction/day	145,002
Gallons of gasoline saved/day	7,830

Travel time impacts:

There would be a small increase in in-vehicle time for most users, and some waiting time at the home-end of the AM trip (pickup at doorstep).

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
62.5	115	152	173	194	213

Kg/day CO reduction in December 1983:	1542
" " " " " 1987:	3286

Kg/day NOx reduction in December 1987: 273

Regional development impacts

Land use:

Less parking space would be required, freeing urban land for more productive uses.

Economic:

A reduction in the requirement for public facilities may allow some tax savings.

Social:

The project is expected to reduce the number of accidents.

Environmental:

None cited.

Capital and operating costs and funding sources	Capital costs, federal	None
	Capital costs, state	None
	Capital costs, local	None
	Capital costs, total	None
	Life of project	Not applicable
	Annualized capital cost	None
	Change in annual O&M costs	\$162,500 (1)
	Total annual project cost	\$162,500.
	Notes: (1) Total annual cost for Office of Ridesharing is \$650,000 consisting of 25% state and 75% federal funding. It is assumed that 25% of this budget will be expended in the four-county DVRPC region.	
Cost effectiveness	Total annual project cost/kg HC reduced in 1987:	\$763
Responsibilities	The New Jersey Office of Ridesharing would be responsible for all aspects of the program.	
Commitments	The New Jersey Office of Ridesharing is committed to a program of employer ridesharing promotion: See Appendix D.	
References	None	

PROJECT NJ: 8-1

I-295 INTERCHANGE AT WOODCREST PATCO STATION

Description	In this project, a full interchange would be constructed along interstate highway 295, serving PATCO's Woodcrest Station. Also, the station's parking area would be expanded from 750 to 2600 spaces. The new interchange would be much more convenient than the use of local streets for park-and-ride station access.
Sites	The primary area served would probably lie within 5 miles north and five miles south of Woodcrest interchange on I-295. However, some drivers traveling from a much greater distance would take advantage of the new intermodal facility.
Schedule	The project would be completed in 1984.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	1,446
Auto VMT reduction/day	13,093
Gallons of gasoline saved/day	611

Travel time impacts:

New park-and-ride users would experience a small increase in travel time due to the need to transfer; also, for some diverted auto drivers the combination auto-rail trip to Philadelphia may be more circuitous (depending upon route usually driven), as I-295 is a north-south highway. However, the trip to Woodcrest Station would be relatively free from highway congestion as many cars would be driving in a direction opposite or tangential to major peak hour flows. For some existing park-and-ride patrons, travel time may be reduced, as I-295 would permit faster access to PATCO than is allowed by local roads to this and other stations.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
0	0	25.3	22.1	19.5	17.3

Kg/day CO reduction in December 1983:	0
" " " " " 1987:	170.6
Kg/day NOx reduction in 1987:	36.3

Regional development impacts

Land use:

There may be a small increase in the density of development around I-295 interchanges providing easy access to the Woodcrest Station, if permitted by local zoning.

Economic:

None cited.

Regional development impacts (cont'd)	Social: None cited. Environmental: None cited.	
Capital and operating costs and funding sources	Capital costs, federal	$35,463,238 (1)
	Capital costs, state	$ 3,940,360 (1)
	Capital costs, local	
	Capital costs, total	$39,403,598
	Life of project	30 years
	Annualized capital cost	$ 1,313,453
	Change in annual O&M costs	$ 2,500
	Total annual project cost	$ 1,315,963
	Notes: (1) For the interstate portion of the project (I-295 ramps), with a 90%:10% federal-state apportionment.	
Cost effectiveness	This is primarily a transportation improvement project. There is an air quality benefit whose costs amount to $76,067 per kg of HC emission reduced in 1987.	
Responsibilities	NJDOT will be responsible for this project.	
Commitments	NJDOT is committed to the project's completion. See Appendix D.	
References	Reference 2, pp. 117-118	

PROJECT NJ: 8-2

PATCO LINDENWOLD STATION PARKING EXPANSION

Description

In this project, the parking lot at the Lindenwold Station would be expanded from 2895 to 3295 spaces (an increase of 400 spaces). This would help to satisfy the demand for station parking, where free parking spaces presently exhibit a 95% occupancy rate during working hours, and attract additional riders who are now discouraged by the difficulty of finding station parking.

Sites

The Lindenwold Station is at the present eastern terminus of the Lindenwold Line; the areas served would include the suburbs around Lindenwold, the Route 73 corridor to Blue Anchor, and the Route 30 corridor to Berlin, Atco, and points east to Atlantic City, all of which may provide park-and-ride commuters with access to the PATCO station.

Schedule

The project would be completed by July, 1982.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	143
Auto VMT reduction/day	1371
Gallons of gasoline saved/day	64

Travel time impacts:

For diverted auto trips, the increase in travel time due to transfer and waiting time at stations should be offset by the avoidance of highway traffic congestion on congested arterials leading into Philadelphia. For some existing station users, there should be small reduction in time spent in cruising in search of a vacant space.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
3.3	3.0	2.6	2.3	2.0	1.8

Kg/day CO reduction in December 1983:	26.2
" " " " " 1987:	17.9

Kg/day NOx reduction in 1987:	3.8

Regional development impacts

Land use:

There may be a small increase in the density of development in areas surrounding the station and along major highway corridors leading to the PATCO line, if permitted by local zoning.

Economic:

None cited.

Social:

None cited.

Environmental:

None cited.

Capital and operating costs and funding sources	Capital costs, federal	$560,000
	Capital costs, state	$ - 0 -
	Capital costs, local	$140,000
	Capital costs, total	$700,000
	Life of project	30 years
	Annualized capital cost	$ 23,333
	Change in annual O&M costs	$ 1,200 (1)
	Total annual project cost	$ 24,533

Note: (1) For parking lot lighting; not including snow removal and other maintenance expenses.

Cost effectiveness	This is primarily a transportation improvement project. There is an air quality benefit whose costs amount to $13,629 per kg of HC emissions reduced.
Responsibilities	The Delaware River Port Authority would be responsible for construction and maintenance of the expanded parking
Commitments	DRPA is committed to this project; See Appendix D.
References	Reference 2, pp. 111-112 Reference 25, p. 17

PROJECT NJ 11-1

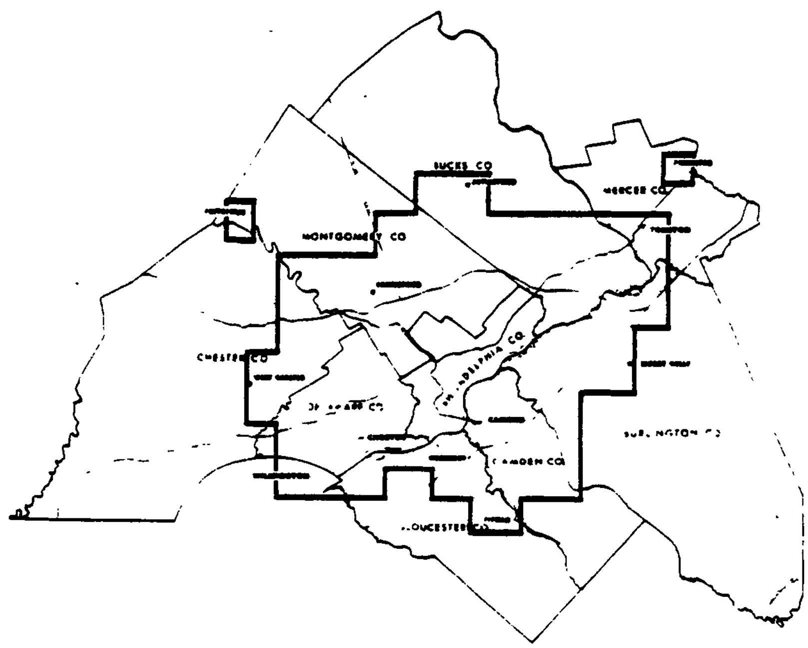
PREFERRED BICYCLE ROUTE MAP

Description

This project includes the preparation and distribution of 10,000 copies of a map of Preferred Bicycle Routes for the urban portion of the Delaware Valley region. It is assumed that 2800 of the maps will be sold to the residents of New Jersey. The availability of the map, which is designed for field use by bicyclists, will facilitate bicycle travel, especially for persons who would not use a bicycle because they are not familiar with alternative routes. The availability of this map will increase commuter utilization of the bicycle mode and may also enhance recreational use. Impacts will be greater in summer months when weather for bicycle travel is best and when ozone violations are most frequent.

Sites

The index map below identifies the area covered by the map. Most of the urbanized portion of the region is included.



Schedule

The map will be completed and published in summer 1982.

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to bicycle user trips/day	2,400
Auto VMT reduction/day	4,800
Gallons of gasoline saved/day	260

Travel time impacts:

Travel time for those switching from auto to bicycle will be increased overall. Those whose trips are in congested locations may experience a reduction in travel time.

Emissions impacts	Kg/day HC reduction in July: 1982: 6; 1983: 10; 1984: 11; 1985: 13; 1986: 14; 1987: 14

1982	1983	1984	1985	1986	1987
6	10	11	13	14	14

Kg/day CO reduction in December 1983:	204
" " " " " 1987:	297
Kg/day NOx reduction in 1987:	9

Regional development impacts

Land use:
None cited

Economic:
Operational cost savings for bicyclists

Social:
Improved physical fitness for bicyclists

Environmental:
Noise reduction associated with fewer auto trips

Capital and operating costs and funding sources

Capital costs, federal	$12,000 (1)
Capital costs, state	$ -0-
Capital costs, private	$ 5,000 (1)
Capital costs, total	$17,000 (1)
Life of project	5 years
Annualized capital cost	$ 3,400
Change in annual O&M costs	—
Total annual project cost	$ 3,400

Notes: (1) Costs are for 10,000 initial copies. A grant from Michelin Tire will permit printing on no-tear paper, enhancing the map's usable life. A fee for the map will generate revenue for distribution, updating and reprinting.

Cost effectiveness

This project produces a kg of HC reduction (each fair weather day in 1987) for each $77 invested. This measure is highly cost effective due to the relatively low cost and high rate of emission reduction. Reductions are high because each auto trip is replaced by a bicycle trip with zero emissions; all replaced trips are "cold start."

Responsibilities

The Greater Philadelphia Bicycle Coalition will be responsible for printing and disseminating the map and will be responsible for any revision and republication.

Commitments

Greater Philadelphia Bicycle Coalition commits itself to the above responsibilities. See Appendix D.

References

Ref. 10

PROJECT NJ 11-2

BICYCLE PLANNING AND DESIGN GUIDELINES

Description	The guidelines described on the opposite page will become an integral part of the New Jersey Department of Transportation's design criteria for new projects and for modifications to existing roadways. The provisions called for in the guide lines will be adopted where economically feasible and where such shared use of the roadway will not present a safety problem for motorists and bicyclists.	
Sites	Throughout New Jersey	
Schedule	Effective immeidately	
Transportation impacts (1987)	Person-trip reduction/day	None
	Auto user to transit rider trips/day	Not estimated
	Auto VMT reduction/day	Not estimated
	Gallons of gasoline saved/day	Not estimated
	Travel time impacts: Travel time increase (in most cases) for those switching from a automobile to bicycle	
Emissions impacts	Not estimated	
Regional development impacts	Land use: None cited	
	Economic: Will result in extra expenditure of highway funds. Will tend to shift demand from automobiles to bicycles	
	Social: Encourages good health through exercise. Improvements should tend to reduce the per-mile rate of bicycling accidents.	
	Environmental: Bicycling is quieter than automobile travel	
Capital and operating costs and funding sources	Capital costs, federal	90% of total
	Capital costs, state	10% of total
	Capital costs, local	-
	Capital costs, total	Not estimated
	Life of project	
	Annualized capital cost	Not estimated
	Change in O&M cost	Not estimated
	Total annual project cost	Not estimated
Cost effectiveness	Not known	
Responsibilities	The New Jersey Department of Transportation (NJDOT) is solely responsible for application of the guidelines	
Commitments	NJDOT is committed to the use of the guidelines. See Appendix D.	
References	None	

. SUFFICIENT SPACE FOR LANE SHARING

All state funded projects should provide fficient width of smoothly paved surface) accommodate the shared use of the adway by bicycles and motor vehicles. general, 15 feet of smoothly paved rface is required in the outside lane (or ı the outside lane plus adjacent shoulder) accommodate shared use. On roadways th less than—say—1200 ADT, no space addition to the regular travel lane is eeded. On roadways with *high speed* avy truck traffic more space is required 3 feet, or 12 feet plus 6-foot shoulder ninimum).

DRAINAGE GRATES

Wherever possible, drainage grates ould be located outside the "lane shar-ng" area. Only bicycle safe drainage ates should be used on the roadway rface where bicyclists are likely to operate, e. the smoothly paved area defined bove, generally the outside lane, or the itside lane plus the portion of the oulder necessary to make the 15-foot lane sharing" area.

The Department should adopt a schedule r the replacement or modification of isting slotted drainage grates which nfringe upon the "lane sharing" area.

. UTILITY COVERS AND OTHER SURFACE IRREGULARITIES

The roadway—especially where bicy-les operate—should be free from utility overs, or other irregularities which pro-rude above or are sunken below the oadway surface. These should be flush with the roadway surface. Raised roadway eflectors are an obstruction to bicycles. hey should be used as an edge line demarcator only in hazardous areas of poor visibility where necessary to insure notor vehicle safety.

4. SIGNALIZED INTERSECTIONS

Signals at intersections must be de-signed to accommodate bicycle traffic. Where signals are tripped by induction loop detectors, bicycle sensitive loop de-tectors should be used in all legs of the ntersection or push button signal actuators should be placed so as to be visible to and within reasonable proximity to the bicy-clists' expected travel path.

5. RAILROAD GRADE CROSSINGS

Railroad grade crossings should be as smooth as possible. Where railroad tracks do not cross at a right angle, the pavement should be widened or "blistered out" to provide bicyclists sufficient space to cross the tracks orthogonally without entering the motor vehicle traffic stream.

6. MAINTENANCE

The roadway surface on which bicycles operate, i.e. the "lane sharing" area, must be reasonably free of potholes, bumps, seams, and debris. Otherwise, bicyclists will move left to avoid these obstacles and debris (into the motor vehicle traffic stream), or they will risk accident and injury by riding through these obstacles or the debris. Pothole repair and other maintenance activities in the "lane sharing" area should be carried out so that there is a smooth, flush, debris free surface.

In general, bicycles require a higher standard of roadway maintenance than motor vehicle traffic.

7. PLACEMENT OF GUIDE BEAM, SIGN POSTS, ETC.

Guide beam, sign posts, utility poles and the like should not be placed im-mediately adjacent to the "road sharing" space (usually the outside 15 feet). They should be set back at least 1 foot ("shy distance") from this space; otherwise the effective distance of this space is reduced.

8. UNIMPROVED INTERSECTING STREETS AND DRIVEWAYS

Unimproved (gravel, dirt) intersecting streets and driveways should be paved back to prevent surface material (gravel, debris, dust) from migrating onto the bicyclist's riding space (10 feet back for roads, and as far back as practicable for driveways).

9. TSM TYPE IMPROVEMENTS

Attempts to maximize the motor vehicle capacity of intersections should not sacri-fice bicycle access. Where it is absolutely necessary to coopt a bike ridable shoulder for use as a right turn lane, the turning lane and through lane should be made extra wide—say 14 feet—to accommodate the shared use of these lanes by bikes and motor vehicles.

10. UNAVOIDABLE OBSTRUCTIONS

Where there are unavoidable obstacles, obstructions or barriers (e.g. narrow bridges), warning signs or pavement striping should be employed to alert motorists to possible bicycle presence or to otherwide mitigate the obstruction.

Where it is absolutely impossible to provide sufficient space for lane sharing, it is possible in some situations to im-prove conditions by a variety of paint striping strategies. For example, on a 48-foot curbed section roadway, rather than striped for four (4) 12-foot lanes, the roadway could be striped for 11-foot wide interior lanes and 13-foot wide outside lanes.

11. BICYCLE MOBILITY OR ACCESSI-BILITY STUDIES

A bicycle mobility or accessibility study (such as has been done for the Route 31, Route 206 and Route 27 Corridors) should be carried out during the preliminary engineering phase of project develop-ment for all major corridor improvements (new construction and reconstruction). The results of the study should be used as a basis for improving bicycle transportation in the corridor.

PROJECT NJ 15-1

INTERSECTION IMPROVEMENTS AT CO HOTSPOTS

Description

DVRPC has identified 15 intersections in New Jersey which will exceed standards for CO after 1982. One will still be in violation after 1987, according to the model which EPA recommends. This strategy includes the advancement to top priority of programmed improvements at these intersections. Where programmed improvements fail to solve the hotspot problem, it also requires that NJDOT, and local government examine the solutions proposed by a consultant (Reference 40) and jointly choose the best one which eliminates the violation.

Sites

1. W. State and N. Warren, Trenton
2. Market and S. Warren, Trenton
3. Perry and Stockton, Trenton
4. N. Willow and W. State, Trenton
5. Perry and Montgomery, Trenton
6. Broadway and Federal, Camden
7. Haddon and Federal, Camden
8. Broadway and Mercer, Gloucester City
9. Broadway and Market, Gloucester City
10. Haddon and Browning, Collingswood
11. Haddon and Collings, Collingswood
12. Haddon and Cuthbert, Collingswood (1987 violation predicted)
13. Kings Highway and Potter/Grove, Haddonfield
14. Kings Highway and Haddon, Haddonfield
15. Kings Highway and Warwick Road, Haddonfield

Schedule

Assumed that improvements will be instituted before December 1983

Transportation impacts (1987)

Person-trip reduction/day	None
Auto user to transit rider trips/day	None
Auto VMT reduction/day	Negligible (1)
Gallons of gasoline saved/day	Negligible (2)

Travel time impacts:

Inasmuch as the purpose of the proposed solutions is to speed the flow of vehicles, through the intersection, some travel time is reduced in each instance. Time saved is not calculated, however.

Notes: (1) Auto VMT may be slightly reduced due to some drivers no longer taking circuitous detours to avoid congested intersections.
(2) The improved speeds in the vicinity of each improvement will permit a small gasoline savings.

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
-	-	-	-	-	-

Kg/day CO reduction in December 1983: (1)
" " " " " 1987: (1)

Kg/day NOx reduction in December 1987: --

Emissions impacts (cont'd)	Note: (1) EPA hotspots model predicts "worst case" CO concentrations directly from traffic characteristics without the intervening step of calculating CO emissions reductions. Although CO is reduced at each intersection, regional CO is not significantly affected through those improvements.
Regional development impacts	Land use: Improved traffic flows may attract more traffic and enhance the commercial attractiveness of the affected streets. Economic: See land use. Also, removal of parking in some instances may be detrimental to local businesses. Social: None cited. Environmental: None cited.
Capital and operating costs and funding sources	Capital costs, total — (1) Life of project — 10 years Change in annual O&M costs — (2) Total annual project cost — Not available Notes: (1) Capital costs range from being essentially free where minor changes such as signal timing can come from routine operations budgets to a high of about \$75,000 where actuated signal timing is recommended. In most cases, solutions costs less than \$10,000. Because so many alternatives are possible, it is difficult to estimate the cost of all improvements; however, \$150,000 appears to be maximum. (2) Slight additional O&M costs may be possible due to a requirement to maintain interconnected signals, etc.
Cost effectiveness	Not available
Responsibilities	NJDOT, Trenton City and Camden County to implement programmed improvements and to select best alternatives for other intersections in cooperation with local governments. NJDOT and local traffic engineering offices to effect minor changes.
Commitments	The City of Trenton is committed to carrying out improvements to Intersections 4 and 5. The State of New Jersey will examine the problem and the proposed solutions at Intersections 1 and 2. If improvements are advised, New Jersey DOT will program the improvements with priority. The County of Camden has included improvements to Intersections 6, 8, 10, 11, 13 and 14 in the region's Transportation Improvement Program. Intersections 3, 7, 9, 12 and 15 carry no commitment; however, only Intersection 12 is predicted to still be in violation by 1987. DVRPC will solicit support for initiating one of two solutions proposed by our consultant, either of which will eliminate the hotspot before 1987. See Appendix D for details.
References	Reference 40

PROJECT NJ 19-1

EDUCATIONAL CAMPAIGN TO REDUCE AUTOMOBILE EMISSIONS

Description	A campaign to raise awareness of efficient automobile driving techniques, resulting in appreciable reductions in extended idling and cold starts, and in better trip planning. The campaign can be carried out in two phases, simultaneously or staggered. The first would emphasize driver education and direct mail advertising and promotion through automobile retailers; a second phase would include a media campaign featuring prominent spokespersons in television, radio and magazine public service announcements, and interviews. Effectiveness of the campaign is dependent upon cooperation of public; it is estimated that 10% of all drivers contacted will adopt efficient driving techniques.
Sites	Phase 1: Driving courses administered regionwide (in both the Pennsylvania and New Jersey portions of the DVRPC region), retail promotion regionwide, direct mail and other promotion concentrated in areas with high trip incidence and where households with two or more cars are prevalent. Phase 2: Media campaign carried out regionwide, but targeted to specific market segments to achieve wide exposure of efficient driving objectives.
Schedule	To be carried out 1984 through 1987.

Transportation impacts (1987)

Person-trip reduction/day	$11,711
Auto driver to auto passenger trips/day	$ 1,200
Auto trip reduction/day	$ 6,988
VMT reduction/day	$88,000
Gallons of gasoline saved/day	$ 4,800
Travel time impacts:	None

Emissions impacts

Kg/day HC reduction in July:

1982	1983	1984	1985	1986	1987
0	0	40	67	89	105

Kg/day CO reduction in December 1983:	0
" " " " " 1987:	1,561
Kg/day NOx reduction in 1987:	160

Regional development impacts

Land use:

Emphasis on efficient trip planning may lead to different traffic distribution patterns in targeted areas.

Economic:

None cited.

Refional development impacts (cont'd)	Social: Appeals to civic and personal values; advances greater public awareness of need for energy conservation; provides for adult educational opportunities; and may promote personal interactions among groups of people seeking solutions to shared problems. Environmental: None cited.
Capital and operating costs and funding sources	Capital costs, federal — None Capital costs, state — None Capital costs, local — None Capital costs, total — None Life of project — 5 years Annualized capital cost — None Change in annual O&M costs — \$96,000 (1)(2) Total annual project cost — \$96,000 Notes: (1) Cost for both states (2) One third of costs assumed to be borne by private sources.
Cost effectiveness	Total annual project cost/kg HC reduced: \$353
Responsibilities	DVRPC and member governments to define, develop and coordinate. Campaign carried out with assistance by and involvement of private sector.
Commitments	DVRPC staff commits to the preparation of a detailed work program to be submitted as part of the FY 1984 Integrated Work Program; the DVRPC Board and NJDOT commits to considering the establishment of such a program.
References	Ref. 11

2.5 Demonstration of Attainment

Although preliminary analyses of the data suggests that the CO standard will likely be attained throughout the region by 1983, the EPA-prescribed "EKMA" model indicates that additional hydrocarbon emission reduction may be needed to attain standards for ozone. However, an analysis by Pennsylvania Department of Environmental Resources indicates that there is sufficient uncertainty in the model that these reductions may not be required.

2.5.1 Ozone

In Section 1.5 it was pointed out that a shortfall of approximately 43,000 kg/day may exist in the volatile organic compounds (VOC) emission reductions which must be eliminated if the ozone standard is to be attained. If the measures described in Section 2.4 were to be implemented, a reduction of approximately 1,600 kg/day total hydrocarbons (HC) or 1,400 kg/day VOC would be achieved by 1987. Table 2.1 indicates the yearly programmed reductions occurring from each measure during 1982 through 1987, in total HC. Also shown are the state and regional totals. These reductions represent only 3% of the calculated emission reduction required for attainment.

Meetings occurred during March and April 1982 between the state environmental agencies, EPA, Philadelphia AMS and DVRPC in order to determine (1) the accuracy of the calculated shortfall and the ranges of confidence in the number; (2) the possibility of adding more controls as a part of the 1982 State Implementation Plans in order to reduce emissions still further by 1987; and (3) if and when standards will be attained after 1987 in the absence of further controls.

Some conclusions of these meetings are made here:

- It appears impractical to increase significantly the reductions from mobile source controls -- the plan recommends all "reasonably available" controls.
- Overcoming the calculated shortfall exclusively through mobile source controls is impossible. It would require eliminating 43,000 of the total 97,000 VOC projected for 1987. Note that in 1987, mobile sources contribute only slightly more than 20% of the total VOC emissions.
- Extension past 1987 will result in some additional mobile source reductions through introduction into the fleet of still cleaner cars.
- There are a number of transportation improvement projects for which air quality benefits have not been claimed because, except in the aggregate, they are small. For example, projects in the New Jersey Annual Element of the Transportation Improvement Project for FY 1982 amount to 90 kg/day reduction in emissions, spread among 24 projects.
- The states agreed that each other's inventories of 1980 point and area source inventories and projections for 1987 were compatible. After several adjustments, it was agreed that each inventory was accurate.

TABLE 2.1

HYDROCARBON EMISSION REDUCTIONS BY YEAR
RECOMMENDED MOBILE SOURCE CONTROL STRATEGIES

(kg/day - typical summer weekday)

Project Number		Project Title	1982	1983	1984	1985	1986	1987
PA	3-1	New Rapid Transit Vehicles	-	312	253	219	194	176
PA	3-2	New Light Rail Vehicles	21	16	13	11	10	9
PA	3-3	New Buses	48	57	72	84	96	107
PA	3-4	R.T. and L.R. Station Improvements	30	34	37	34	30	27
PA	3-5	Regionwide Shelters and Signs	7	7	7	7	7	7
PA	3-6	Transit Safety and Security	-	144	114	99	76	80
PA	3-9	Rt. 66 Trolley Line Extension	-	14	11	10	9	8
PA	3-10	Newtown C.R. Line Electrification	-	-	-	-	-	31
PA	4-1	Regional Ridesharing Program	-	91	151	194	230	257
PA	6-1	Airport H.S. Line	-	-	56	51	47	44
PA	6-2	Center City Comm. Conn.	-	6	5	197	176	159
PA	7-1	Center City Parking Policies	-	11	9	7	7	6
PA	11-1	Preferred Bicycle Route Map	16	24	29	34	35	32
PA	11-2	Other Bicycle Measures	-	-	-	-	-	-
PA	19-1	Educational Campaign . . .	-	-	61	105	140	167
		SUB-TOTAL PA ONLY	122	716	818	1052	1057	1110
NJ	3-3	New Buses	7	48	43	38	34	31
NJ	3-4	Rehabilitated Buses	10	19	27	24	22	20
NJ	3-5	Two-way Bus Radios	-	2	16	14	12	11
NJ	3-6	Improved On-time Performance	15	26	35	31	27	24
NJ	3-7	Extension of NJT Routes in Phila.	-	4	4	3	3	2
NJ	3-8	Rationalization of Fare(s)	9	8	8	7	6	5
NJ	3-9	Park and Ride Bus Service	-	13	21	27	32	28
NJ	3-10	Woodbury and Turnersville Park and Ride	4	3	3	3	2	2
NJ	4-4	Statewide Ridesharing Program	63	115	152	173	194	213
NJ	8-1	I-295 Interchange at Woodcrest	-	-	25	22	20	17
NJ	8-2	PATCO Lindenwold Parking Exp.	3	3	3	2	2	2
NJ	11-1	Preferred Bicycle Route Map	6	10	11	13	14	14
NJ	11-2	Bicycle Planning and Design Guidelines	-	-	-	-	-	-
NJ	15-1	Intersection Improvements (CO)	-	-	-	-	-	-
NJ	19-1	Educational Campaign . . .	-	-	40	67	89	105
		SUB-TOTAL NJ ONLY	107	251	388	424	457	474
		REGIONAL TOTAL	239	967	1206	1476	1514	1584

- o The states agreed that there is great uncertainty in the calculation of the emission reduction necessary for standard attainment, and that it may be the case that the ozone standard will be attained by 1987. See the discussion of PennDER's variability analysis of EKMA in Section 1.5

2.5.2 Carbon Monoxide

The Transportation Element for Southeastern Pennsylvania of the 1979 State Implementation Plan (SIP) demonstrated that carbon monoxide standards would be attained in Philadelphia by spring 1983 with an Inspection and Maintenance program in effect or fall 1984 without (Ref. 28, page 2-10). The New Jersey 1979 SIP indicates that CO violations are likely to end in the region by 1985. (Reference 29). Recent air quality data, however, as presented in Section 1.2 (Table 1.3 and Figure 1.1) demonstrate that the region may currently be meeting the CO standards.

In Philadelphia, the City's Air Management Services (AMS) has been developing a complex model to predict CO concentrations under worst case meteorological conditions and under variable traffic conditions. The finding of this study is that CO standards will be violated in 1983 (the year to which EPA extended attainment) only at the intersection of Broad and Vine Streets. The model also demonstrates that even this violation will disappear before 1987. Vine Street is a part of the Interstate highway system and is scheduled to be reconstructed as a depressed limited-access highway. It is assumed, although not demonstrated, that the reconstruction will eliminate the CO violations. Meanwhile, to confirm their findings, AMS is establishing a monitor at Broad and Vine. At the end of 1982-83 winter season, it may be able to be demonstrated that CO violations do not presently occur in Center City, or so infrequently occur that attainment within the near future is assured.

In spite of the apparent success of federal motor vehicle controls to eliminate CO violations, DVRPC is recommending the implementation of traffic flow improvements to reduce congestion at 16 intersections in New Jersey (Project 15-1) which are predicted to be in violation of CO standards using EPA hotspot analysis guidelines.

3 THE ADVANCEMENT OF CLEAN AIR

3.1 INTRODUCTION

The early attainment of clean air for the Delaware Valley requires that continued reduction of emissions occur from transportation sources. The programs and projects recommended in Section 2, as part of the State Implementation Plans (SIP) of Pennsylvania or New Jersey, need to advance through the transportation planning process. Section 3.2 describes the current process and the steps required to bring the process into conformity with the SIPs. Section 3.3 and 3.4 describe two new components of the SIPs: a plan for monitoring the success of the plan and a contingency plan for addressing a shortfall in progress toward attainment.

3.2 CONFORMITY OF TRANSPORTATION PLANNING PROCESS

The present transportation planning process was described fully in the 1979 SIP Revision for Pennsylvania prepared by DVRPC and will not be repeated here. (Reference 28, Section 4.) A series of four reports on the transportation planning, programming, budgeting and implementation process in the Delaware Valley region is currently being conducted by a private consultant with funds provided directly by EPA. The concluding report will make recommendations for improving the process, with particular attention to assuring that air quality issues are fully addressed. The first two reports are completed (References 38 and 39).

The discussion below is directed only toward the incorporation of air quality measures into the planning process. It indicates that the transportation planning process conforms to the current SIPs, but that changes will be required in the transportation plans with the adoption of the 1982 Transportation-Air Quality Plan and subsequent revision of the SIPs to maintain conformity.

The Clean Air Act requires the coordination of the transportation and air quality planning processes for the purpose of promoting cleaner air. Each year DVRPC prepares a document entitled, Transportation-Air Quality Annual Report. The 1981 Annual Report was approved by the DVRPC Board in May, 1982.

The Annual Report reviews the progress made in implementing the transportation elements of the state implementation plans, and reports on the air quality evaluation of the 1981 Transportation Improvement Program's Annual Element, and the short and long range transportation plans. EPA and FHWA require that, based on this information, the regional planning agency must make a finding of the conformity of the transportation planning process with the SIPs based on a number of criteria. The Board determined that in 1981 the transportation planning process did conform to the SIPs.

Table 3.1 shows the evaluation criteria for determining conformity and how the criteria have been met. All of the criteria appear to have been met. Transportation projects included in the 1979 SIPs are being implemented on schedule, the Newtown Line Electrification issue was resolved, and mobile source emissions are estimated to be lower than targeted. In addition, both the short and long range transportation plans show a small net reduction in emission as compared to the no-build alternative.

TABLE 3.1

SUMMARY OF PROGRESS IN MEETING CONFORMITY PLANNING REQUIREMENTS

Evaluation Requirements		Status	Comments
Area	Criteria		
1. Conformance of Long Range Plan (LRP)	*LRP must contain all applicable projects in SIPs.	The LRP contains all applicable SIP projects.	--
2. Conformance of Transportation System Management Element (TSME)	*TSME must contain all applicable projects in SIPs. *TSME must not increase HC/NOx emissions and not create or exacerbate CO hot spots.	TSM plan due for adoption by DVRPC in early 1982.	Evaluation of the emission impact of the proposed TSM plan shows small reductions.
3. Conformance of Transportation Improvement Element (TIP)	*TIP must contain all projects in SIPs *TIP must reflect SIPs schedule for project initiation and completion.	All projects in SIPs are in TIP. There are minor schedule changes except in the case of the Newtown Line Electrification project.	The Newtown Line Electrification project issue was resolved by amending the PA SIP.
4. Conformance of the TIP Annual Element (AE)	*AE must show HC emissions consistent with SIPs. *Where SIP does not contain numerical HC reductions, there must be no emission increase in either state. *Projects in AE must not create CO violations nor exacerbate existing ones.	Evaluation of the FY1982 AE shows insignificant changes in HC emissions. No potential CO problems were identified.	--
5. Conformance of Integrated Work Program (IWP)	*IWP must contain planning work activities in SIPs. *SIP planning schedule must be met.	The IWP contains all the planning projects in the SIPs. Preparation of the 1982 SIP revision is proceeding on schedule.	--

The following five documents, referred to in Table 3.1, describe the future of transportation in the region and are affected by the Transportation-Air Quality Plan.

The Long-Range Element (or Plan): At DVRPC, the long range plan is known as the Year 2000 Transportation Plan. Adopted in June 1981, it will be published in the summer of 1982. It identifies transportation policies, facilities to be built and major changes in existing facilities. (Reference 37 describes the testing and evaluation of the proposed plan.)

The Transportation Systems Management Element (or Plan): The TSM plan (Reference 20) is a short-range plan and includes a large and diverse number of proposed actions in traffic engineering, public transportation, pricing, management, operational and other improvements to the existing system. The Transportation Systems Management Plan will be published in fall 1982.

The Transportation Improvement Program (TIP): The TIP is published annually in July and consists chiefly of a list of all transportation improvements to be advanced during the next six years. The TIP draws projects from both the long range and short range plans. (See Reference 25).

The Annual Element: The first year the TIP is referred to as the Annual Element and consists of a cost-constrained list of high priority projects.

The Integrated Work Program (IWP): The IWP describes all planning activities to be accomplished by DVRPC (or by others funded through DVRPC) during the fiscal year (July 1 - June 30).

Adoption of the Transportation-Air Quality Plan by the DVRPC Board represents a policy commitment to develop supportive transportation planning documents. DVRPC intends to bring its long range and TSM plans, its TIP and annual element, and its IWP into conformity with the State Implementation Plans of Pennsylvania and New Jersey. Rules of the FHWA and UMTA (FR, January 26, 1981 pp. 8429-8431) require that these federal agencies apply conformity criteria in their own review and approval procedures.

3.3 Monitoring Plan

A monitoring plan provides for the periodic assessment of the effectiveness of transportation strategies included in the State Implementation Plans (SIPs). (The requirements of a monitoring plan are contained in guidance published in the Federal Register on January 22, 1981, pp. 7184, 7187 and 7191.) The monitoring plan basically must demonstrate how travel (number of trips and vehicle-miles) is responding to transportation strategies which have been initiated. It also must evaluate the basic assumptions upon which these projections were made; for example, population growth and baseline vehcile-miles of travel must be monitored.

Monitoring of the success of projects to produce the anticipated reductions in emissions is a difficult task. Seldom are direct measures of travel impacts available. An increase in the use of a transit facility, for example, which has been improved by a SIP measure may not be attributable to the subject project, but be caused by exogeneous factors, such as the cost or availability of gasoline. Ideally, each individual project and program should have its own method of measuring success even if it is a surrogate measure imperfectly correlated to a true measure of its effectiveness. The most accurate methods of determining success are through surveys and before-and-after traffic counts at affected points in the highway network. These approaches, however, are expensive. In an era of declining funds for transportation planning, resources may be best allocated elsewhere.

Due to the difficulty involved, it seems economical to postpone the design of an approach for monitoring each measure until such time as it is clear that the measure will be included in a SIP. DVRPC commits itself to this essential task as a part of supplementary work to be completed during FY1983.

An approach for developing a monitoring plan has been outlined in DVRPC's 1981 Work Program. It includes the following steps:

(1) Determine the transportation system performance indicators appropriate to each strategy or set of strategies.
(2) Determine the methods to be employed, the data to be collected, the frequency of the assessment and other particulars for each of the indicators selected.
(3) Determine how the monitored data will signal any of the following: (a) cessation of the strategy, (b) modification or extension of the strategy, and (c) initiation of substitute strategies to be drawn from the "reserved" measures.
(4) Determine which agencies can accept responsibility for executing various aspects of the monitoring program; estimate the annual costs and propose how the program elements can be funded.
(5) Consult with each of the above agencies as to the conditions under which it will accept the responsibility for monitoring.
(6) Propose a single best monitoring program.

In fulfilling the above tasks, two observations will be borne in mind: (1) the use of data already being collected will be relied upon in every instance; no new data collection is anticipated. Often the measures used will be surrogates. (2) Relatively more effort will be devoted to measures which can be reversed, ended or dismantled at a savings to public investment. Less effort will be devoted to measures which cannot be terminated or which have been instituted for other reasons in addition to air quality.

The Annual Report on Transportation-Air Quality Planning, published during the last two years and planned to continue, will report on the progress which is perceived to take place as a result of transportation control strategies. Past reports have relied upon rather gross measures such as indicators of regional vehicle-miles-of travel, regional population estimates, transit ridership figures, carpools and vanpools reported by ridesharing agencies auto occupancy studies and reports on gasoline consumption. As experience is gained, DVRPC staff expected that more precise evaluations of each strategy will be possible.

3.4 Contingency Plan

Guidelines for Transportation-Air Quality Planning require that states submit contingency plans for use in the event that "reasonable further progress" in attaining standards is not made. This may occur if(1) committed programs and projects fail to get implemented, or (2) programs and projects fail to deliver the emission reductions projected in the SIP. (See the Federal Register, January 22, 1981, pp. 7184, 7187 and 7192.)

The contingency plan as defined in the Federal Register has two parts. In large urbanized areas, it requires that local planners develop a comprehensive list of projects which may adversely affect air quality. Federal regulations (FR, January 26, 1981, pp. 8427 and 8430) further require that upon notification by the EPA that a SIP revision has been requested and for 12 months after the notification or until the SIP is formally revised, whichever comes first, the UMTA and FHWA will not be permitted to authorize construction of any of the listed projects. This part of the contingency plan does not appear applicable to a region like Philadelphia. The six-year Transportation Improvement Program for the region contains many measures to improve the public transportation system, all of which tend to suppress the amount of automobile travel. Highway projects are primarily Transportation Systems Management (TSM) projects designed to ease congestion in problem areas. These projects, too, generally have beneficial effects upon mobile source emissions. Most large scale projects in the TIP constitute missing links in a minimal and long-planned network of limited access highways. It does not appear that any programmed project will adversely affect air quality in the region. The air quality evaluation of the long-range regional transportation plan shows that emissions will be lower than for the no-build alternative.

The second part of the contingency plan is a description of the process for determining additional transportation measures which can be employed in the event they are required. This process may be commenced when the EPA requests a SIP revision. Transportation control measures may be required at some future date even if none were to be included in the 1982 SIP revision.

In the previous section it was explained that an effort will be maintained by DVRPC to monitor the success of each adopted measure and to compare in the Annual Report the estimated emission reduction achieved with that predicted in the SIP. If, in sum, the emission reductions are falling short of that for which the transportation sector has assumed responsibility, the Annual Report will report it. Further, it will report progress or delays in implementing each adopted measure. It is then EPA's prerogative to cite that progress in attaining standards is insufficient and request a SIP revision.

It is DVRPC's intent to cooperate with EPA in amending the SIPs for transportation controls within the Delaware Valley. However, if direct funding is not provided, DVRPC must rely upon cooperation of federal and state transportation agencies to approve work programs which include the necessary projects.

If necessary to find further measures to reduce emissions, DVRPC would first draw upon those measures in the reserved list of strategies appended to this plan.

Reserved strategies are those which appear to produce emission reductions, but which, for one of several reasons, are not recommended at this time. Section 2.3 discusses the various kinds of reserved measures.

Several strategies consist of many small projects, the air quality impacts of which are only significant in the aggregate. A number of these projects will be completed during the 1982 to 1987 period. In the event of a request for a SIP revision, such projects which are completed or which are committed to being completed can be evaluated and the emission reductions used to reduce the shortfall.

A second group of strategies to look to are those which were studied in detail, caused signficant reductions, appeared to have few implementation problems, but for which commitments were unable to be obtained. In these cases, little needs to be done except to obtain the necessary commitments from funding and operating agencies.

If the above two kinds of strategies fail to provide the necessary reductions, other reserved measures will need to be studied. It would be reasonable to select, on the basis of past analyses, the most promising strategies which together are likely to satisfy the attainment requirement. The technical approach employed for similar measures during the recent detailed studies will provide the model for what analysis needs to be done.

As in the case of the 1982 SIP revision, the DVRPC's Transportation Technical Advisory Committee will guide the planning and make recommendations to the Planning Coordinating Committee and the Board concerning amendments to the plan. A public hearing on amendments will be held prior to the Board's adoption.

During the compilation of this plan it became clear that a real threat to the continued operation of the region's commuter rail lines exists. A study, "Commuter Rail Contingency Plans" was commissioned by the DVRPC Board to develop "alternative mobility options for the Delaware Valley" in the event of a short-term or long-term shutdown. The present commuter rail system is an important element in the transportation network and therefore also in the baseline emissions inventory. Should a shutdown occur and the commuter rail contingency plan be put into effect, a re-evaluation of baseline emissions must take place. To the extent that the alternatives result in a significant emissions increase, additional measures may be drawn from the reserved strategies to return the trend to one of reasonable further progress.

APPENDIX A

Reserved Measures (See Section 2.3)

PENNSYLVANIA

New Commuter Rail Vehicles

In this project, 70 new commuter rail cars would be purchased in 1983 to allow the replacement of the remaining Reading "Green Cars" (from the 1920s) with modern equipment (Ref. 25, p. 46,, Ref. 26, p.81). The new silverliners would allow greater speed, less noise and vibration, and better climate control than the equipment replaced. This project would cause an increase in ridership of 864 per day in 1987. This would amount to a 17 kg/day HC emission reduction, under the present operating scheme with stub-end terminals in the CBD area. Considering the recent cuts in commuter rail service, it is not at present certain whether the new equipment would be necessary. For this reason, it is recommended that equipment requirements be re-evaluated after regional decisions have been made concerning the future form and extent of the commuter rail system. This project is of lower priority than the CCCC project, and in any case would result in relatively small new ridership.

Rehabilitated Rapid Transit Vehicles

In this strategy, SEPTA would rehabilitate approximately 30 Broad Street Subway cars, to improve fleet availability and the reliability of service until the new rapid transit cars bcome available. This project is also a backup in case technical difficulties should cause part or all of the new car orders to be cancelled, leaving a short-fall of equipment.

It is assumed that most of the rehabilitated vehicles would be former Bridge Line cars (Ref. 25, p. 18), which are the most modern in design, and that the remainder would be 1938 rolling stock, which although based on the 1928 design are the newest cars presently running.

Rehabilitation of the Bridge Line cars alone would result in a ridership increase of 2753 per day in 1987, if no modern equipment were placed on the line (Ref. 1, pp. 2-20 to 2-23). This would result in a 17.2 kg/day HC emissions reduction. This project is primarily an alternative to the plans to acquire and place in operation modern rapid transit cars.

New Rapid Transit Vehicles

In this project, an additional 25 cars would be purchased for the Broad Street Subway, as an add-on to the present car order (PA:3-1). (Ref. 1 pp. 2-29, 3-2 to 3-4). The latter is expected to satisfy, in terms of number of vehicles, 96% of the fleet requirement of 130 cars. However, it is possible that 125 modern, fast-accelerating rapid transit cars will suffice to provide the same line capacity as 130 of the obsolescent 1928-1938 vintage cars. If it proves necessary to operate 130 or more cars to provide a satisfactory level of service on the Broad Street line, the supplemental car order would allow up to 12 Kg/day HC emission reduction. Considering the $15M cost of the project, and the relatively small air quality benefit, this project is placed on the list of reserved measures.

Rehabilitated Buses

In this project, 125 New Look buses would be rehabilitated, to improve service reliability and upgrade the aesthetics of the vehicles (Ref. 25, p.17). This would allow an increase in 1987 ridersip of 1254 per day (Ref. 1, pp. 2-20 to 2-23), and HC emissions reduction of 5.4 kg/day.

This project is primarily an interim measure to improve the fleet until additional new vehicles are purchased. It would not impact 1987 air quality unless the new vehicle program were delayed, making it necessary to continue operating some of the rehabilitated buses. Therefore, it should be considered an alternative to the recommended SIP project to purchase new buses and a reserved measure.

Premium Bus Service

In this strategy, a premium-fare express bus service, with guaranteed seats, comfortable vehicles, and courteous drivers, would be provided to suburban areas which presently lack adequate public transportation for CBD-bound commuters or which may face the prospect of reductions in commuter rail service. It is presumed that a large intercity-type bus would be used in this type of operation. At the residential end of each route, buses would pick up locally from stops along the highway and park-and-ride lots; they would then run express to Center City, with local distribution along Chestnut Street.

A consultant study conducted as part of the present transportation-air quality planning effort has developed ridership and cost data for three potential routes, providing several analytical models which can serve as a basis for further route evaluation by area transportation planners (Ref. 1, pp. 4-2 to 4-25). One route, to West Grove, via I-95 and US 322, would serve an area which has practically no public transportation service. It could serve as a test for possible future establishment of commuter rail service on the Octararo Branch, presently a little-utilized freight line paralleling U.S. Route 1. The other routes evaluated were to Plymouth Meeting via I-76, and to Levittown via I-95 and Route 63. Fares would be equivalent to commuter rail fares for equal distances: for West Grove - $3.40; for Plymouth Meeting -$2.05; and for Levittown - $3.00. Ten-trip and monthly tickets would be available. Three trips per hour during peak periods, and one per hour off-peak, were assumed. With comfortable seats, air conditioning, bus shelters at stops, etc., a level of amenity similar to that of the commuter rail service could be provided.

The three routes studied would allow a potential HC emissions reduction of 15.9 kg/day. However, in the case of the Plymouth Meeting and Levittown lines, it is felt that competition with extant commuter rail service might produce negative economic impacts on the overall transit operation on the affected corridors. For this reason, the West Grove service appears to be the most viable of the three routes studied, allowing an HC emissions reduction of 11.9 kg/day. However, in this case, it is possible that a different service frequency (2 per hour) would be required to make the line economically viable.

Future study may delineate a number of other routes which would allow comparable savings. As most potential routes would probably involve some competition with the commuter rail system, in future planning, efforts would be made to dovetail bus and commuter rail schedules, alternate park-and-ride stops (with only on-street pickup where bus routes parallel commuter rail stations), and route buses in such a way as to cover somewhat different service areas, to maximize the potential of the total transit corridor (bus plus rail).

Considering the modest savings in emissions, and the fact that further evaluation would be needed to establish the viability of the most promising of the three proposed routes, this strategy is placed on the list of reserved measures.

Improved Bus Service Frequency and Route Modifications: Pennsylvania

There are a number of TSM projects in suburban counties, involving an increase in the frequency of bus service during peak hours (Ref. 20). These include plans for increased service in Doylestown in Bucks County; in Norristown and on US Route 202 in Montgomery County; on bus routes 120 and 121 in Chester County; and on Pa. Routes 13, 320, and 420, on Baltimore Pike, and in Media, in Delaware County. In addition, there are plans to extend bus routes along Ridge Pike and other portions of US Route 422, in Montgomery County.

These improvements would, if implemented, allow a small change in the modal split in favor of transit, and a corresponding reduction in vehicular emissions. However, considering the uncertainty of future funding for transit operations, it may be very difficult to make a commitment to expand suburban service.

Route Y and 59b Electrification

In this project, the route Y and 59b bus routes would be converted to trackless trolley (Ref. 25, p. 43). Both routes are heavily used, and the proximity of other trackless trolley, light rail, and rapid transit lines would allow some savings through common use of substations and maintenance personnel and facilities.

Trackless trolleys allow a higher level of comfort and amenity than diesel buses, with much lower noise, absence of fumes (which while not affecting riders inside the vehicle may be noticeable at passenger stops and terminals), smoother acceleration, quiet electric braking, etc. They have better acceleration at low and medium speeds and may allow a slight improvement in running time, especially on upgrade sections. Finally, the overhead wires provide much better route identity than buses which carry their fuel.

These factors would result in a ridership increase of 534 per day in 1987 (Ref. 1, pp. 2-20 to 2-23). This would mean a 2.3 kg/day reduction in emissions through diversion from automobiles. If this were the only factor considered, this project would appear to allow only a very small improvement in air quality. However, the replacement of diesel buses with electric vehicles will result in at least a 12.5 kg/day reduction in HC emissions, so that total emissions savings would be 14.8 kg/day.

As there is uncertainty about the availability of funds for this project, and the air quality benefits are modest, Route Y and 59b electrification are placed on the reserved list of measures.

Commuter Rail Infrastructure Improvements

This project would include track, roadbed, interlocking, power, catenary, bridge, and grade crossing improvements, new signalling and welded rail for the commuter rail system. It would include an increase in the number of tracks and replacement of the Brill/Arsenal interlockings with an interlocking at 54th Street for improved operating efficiency and safety (Ref. 25, pp. 7-8, 42; Ref. 26, pp. 48, 53). The Brill/Arsenal improvement would alleviate congestion and improve running time where the Airport High Speed line branches off from the Media-West Chester line, resulting in a ridership increase of 205 per day in 1987 (Ref. 1, pp. 2-20 to 2-23). This would allow a 4 kg/day reduction in HC levels.

Frankford El Reconstruction and Station Replacement

In this project, the Frankford Elevated line would be reconstructed to correct structural weaknesses from its northern terminus to a point south of the Girard Avenue station. Improvements would be made on crossovers, signalling, and communcations systems. The City of Philadelphia plans to replace the eleven existing elevated stations with new stations at the same locations (Ref. 25, pp. 9, 44; Ref. 26, p. 53).

The structural work on the elevated line is primarily for safety reasons, and will have no ridership impacts (Ref. 1, pp. 2-20 to 2-23). The replacement of obsolescent stations should have a modest impact on ridership. However, as no CBD stations are involved, it can be assumed that the impact on ridership would be considerably less than that of the recommended Market Street subway-elevated and subway-surface line station improvements.

Market Street West Station

In ths project, a new station would be constructed at 20th Street on the Market Street Subway. This would serve the recent growth of commercial apartment, and hotel development in the CBD area west of City Hall, and relieve peak-hour crowding at the 15th Street Station (Ref. 25, p. 13). This improvement would allow a decrease in walking time for some riders who presently use the 15th Street and 30th Street subway stations, and elimination of waiting time for passengers who transfer at City Hall or 30th Street to the subway-surface system, which has stations at 19th and 22nd Streets.

This project has been estimated to result in a ridership increase of 1170 per day in 1987 (Ref. 1, pp. 2-20 to 2-23). This would allow a 7.3 kg/day reduction in HC emissions. Considering the high cost of the project ($43.7 million), the air quality benefits are rather small. Also, it is probable that improvements in security and aesthetics on the subway surface stations at 19th and 22nd Streets will make the transfer to this mode more acceptable to passengers in the future, and that the ability to run the new LRVs in two-car trains will reduce the crowding that presently inhibits some passengers from making the transfer. The subway-surface line improvements may therefore further reduce the transportation and air quality benefits of the proposed 20th Street station. For these reasons, this project is place on the reserved list.

30th Street Commuter Rail Station Renovation

In this project, improvements would be made to 30th Street station, partly in conjunction with the Northeast Corridor improvement program, and partly with the aim of upgrading the station as a commuter rail facility. The improvements would include replacement of escalators to the upper level, improved lighting, an improved public address system, installation of electronic destination signs, improved ticketing facilities, installation of an escalator to the subway station, and construction of an at-grade, covered walkway to the subway entrance at 30th and Market Streets (Ref. 25, p. 27).

This project has been estimated to result in an 872 rider per day increase in 1987 (Ref. 1, pp. 2-20 to 2-23). This would mean a 17.2 kg/day reduction. Considering the modest level of air quality improvement and the relatively small level of new ridership generated, this project has a lower priority than the CCCC development.

Suburban Commuter Rail Station Renovation

In this strategy, improvements would be made on about 50 commuter rail stations, including parking, signing, lighting, platforms, and buildings. Several Amtrak stations are included in this program (Ref. 25, pp. 42-43; Ref. 26, p. 57). This project would allow a 1078 rider/day increase in 1987 (Ref. 1, pp. 2-20 to 2-23). This would mean a 21.3 kg/day reduction in HC emissions. Considering the modest level of air quality improvement, the relatively small level of new ridership generated, and the fact that station renovation priorities may be changed in the near future (as there may be a curtailment of service at some stations), this project is placed on the list of reserved measures.

Bus Stop Relocation: Pennsylvania

The TSM program includes a number of projects for relocation of bus stops to the far sides of intersections (Ref. 20). These cover bus lines on Pa. Routes 320 and 611 in Montgomery County; bus stops in Media, in Delaware County; and bus routes on Ridge Avenue, Frankford Avenue, Broad Street, and the Arch/Race Street area in Philadelphia. Also included are off-line bus slots for stops on US Route 422 in Montgomery County, and on Bustleton Avenue and City Line Avenue in Philadelphia.

Far-side bus stops allow buses to drive around right-turning traffic which may prevent them from gaining access to the near-side stops. This allows bus service to be speeded up, and should result in a small diversion from private cars to transit. Curb-side bus slots allow buses to pull off main thoroughfares to make their stops, allowing less interference with other traffic, and a slight reduction in emissions.

Considering the limited scale of these projects, the air quality improvement resulting from these improvements will be very small, perhaps negligible.

Coordination of Transit Service: Pennsylvania

There are a number of TSM projects for coordination of transit schedules where there is a mode change at transfer points between bus and rail lines (Ref. 20). These include an areawide program in Bucks County; modifications to bus service along US Route 30 and Pa. Route 320 in Montgomery County, on Pa. Routes 13 and 320 and in Media, in Delaware County; and the Race/Arch Street, Broad Street, Frankford Avenue, and City Avenue areas in Philadelphia. In addition, there is a project for feeder bus service on US Route 202 to the Elm Street commuter rail station in Norristown.

These projects would reduce waiting time, and hence total trip time, for transit users. It is expected that the increase in ridership will be relatively minor; however, in the suburbs, there may be a small reduction in vehicle miles as some park-and-ride commuters switch to the bus as an access mode to the commuter rail system. Overall, the emissions reduction will probably be very small.

Transit Promotional Programs: Pennsylvania

The TSM program includes a number of small transit marketing projects (Ref. 20). These include the Langhorn-Levittown Mall service area in Bucks County; an area program in Chester County; the Pa. Route 13 and Baltimore Pike corridors in Delaware County; and map revision for additional service in the Bustleton Avenue area of Philadelphia.

The ridership impacts of localized marketing programs of this sort are in general relatively small and difficult to quantify.

Transit Permit

In this strategy, a weekly transit permit would be introduced, allowing regular transit users to buy the permit in advance for $5.25 and pay a "drop" fare of 15¢ upon boarding the transit vehicle. This allows regular patrons much of the convenience of the transit pass in not having to carry a large amount of change to ride the SEPTA system, but requiring much less money to be paid in advance as compared to the present, non-discounted $9 Transpass. The permit system would be most beneficial to riders who do not need to make a transfer. For these riders, the permit would be the most economical travel alternative for trip rates of 9.5 to 25 per week. For people making one transfer, the permit would be more economical for trip frequencies of 9.5 to 12.5 per week, while for riders making two or more transfers, the pass would be a cheaper alternative than the permit for passengers making more than 9 trips per week (Ref. 1, pp. 4-26 to 4-40).

It is estimated that in 1987, 1164 additional transit trips/day could be generated using the permit system in addition to he present weekly and monthly passes. This would result in a 5.9 kg/day HC emissions reduction. However, there would be a 0.84% reduction in SEPTA revenues, and administrative costs for fare collection would increase by 10 to 15%. Considering the modest level of emission reduction resulting from this strategy, and the probability of increasing operating costs for SEPTA, this strategy is placed on the list of reserved measures.

Preferential Signals for Transit Vehicles: Pennsylvania

In this measure, preferential signals favoring transit vehicles would be installed along the following routes which operate in mixed traffic, in 1984 and 1985: the Route 47 bus, on 7th, 8th and 9th streets; the Route 23 streetcar, on 10th, 11th and 12th streets; the Route 2 bus, on 16th and 17th streets; the Route 3 bus, on Columbia Avenue; and the Route 26, J, and K buses, on Chelten Avenue. (For a description of these routes, see Ref. 27). In addition, there is a TSM project to improve signal phasing at Broad and Olney Avenue, to expedite transit vehicle movement (Ref. 20) and on-going project to provide preferential signals for Route 66 trackless trolleys on Frankford Avenue.

It is also planned to provide preferential signals for the Route 15 streetcar on Girard Avenue, which has some painted-off exclusive lanes and raised right-of-way. Finally, there is a project for improved signalization and channelization at 34 grade crossings on the Media-Sharon Hill light rail line, which operates mostly on private right-of-way. These improvements would include crossing gates, signal preemption, and new and improved signals.

For these routes, green signals favoring buses, trolleys, or light rail cars would be advanced or extended, with the deficit in green time for cross traffic being made up on the next cycle; hence, there would be no adverse impact on automobile emissions. Where transit vehicles operate on private right-of-way, or on streets under free-flow conditions, signal preemption would allow them to move directly across intersections without delay. For mixed-traffic operation under congested rush-hour conditions, this strategy is somewhat less effective; but even in this case, signal preference reduces intersection delays and allows transit vehicles to move up to passenger stops more speedily. Left-turning traffic may remain a problem for streetcars; this can be accommodated by providing a left-turn phase or a left-turn bypass lane, which has already been done on Girard Avenue. Buses with signal preemption, of course, can maneuver around left-turning vehicles, making special provisions unnecessary.

Improved transit running speeds resulting from signal preference can allow a small modal shift in favor of transit, with a minor, perhaps negligible, reduction in emissions.

Exclusive Lanes for Transit Vehicles: Pennsylvania

Exclusive transit lanes were recommended in a recent study for the City of Philadelphia for major portions of the Route 60 (Allegheny Avenue), Route 56 (Erie Avenue), and Route 6 (Ogontz Avenue) streetcar lines, and for congested sections of the Route 59 (Oxford Avenue) trackless trolley and bus routes 20, 88, and B (Bustleton Avenue) (See Reference 27). Exclusive lanes and traffic light preemption have already been funded and are being implemented for the Erie and Ogontz Avenue lines; transit lanes are planned for the remaining routes in 1983, and preferential signals would be installed on these lines in 1984 and 1985 (not restricted to reserved lane portions). There is also a TSM project to establish a bus lane on Broad Street, between Vine and Erie (without signal preemption).

These improvements allow streetcar lines to be upgraded to light rail standards, and provide better transit route identity. Reserved lanes allow traffic to be kept out of the path of transit vehicles, and will also allow preferential signals to be used more effectively. Reserved lanes for streetcars would be in the center of the street; where left turn lanes are permitted in the right-of-way, a special signal phase might be necessary. For buses and trackless trolleys, directional, peak hour, curb-side "diamond lanes," allowing access to right turning traffic would be utilized; on Bustleton Avenue, southbound AM and northbound PM lanes would be used, while on Oxford Avenue, a southbound lane would be used in the AM peak only.

Air quality impacts of reserved transit lanes depend upon the balance between increased transit ridership (diversion from autos) and increased congestion of motor vehicles where traffic lanes are removed without providing compensatory road capacity by eliminating on-street parking. For the routes in questions, parking removal was not considered politically feasible. Air quality has been calculated to improve for some directional flows and time periods and to worsen for others, with an overall, slightly negative air quality impact, for transit lane improvements without signal preemption (Reference 27, T. XXIV).

However, when traffic light preemption is used in combination with transit lanes, operations can be speeded up even more. Signal preemption allows a reduction in delays about equal in magnitude to that permitted by exclusive lanes. For the two longer streetcar lines recommended for exclusive lanes and signal preemption, delays are as follows:

	Allegheny Ave.	Erie Ave.
% of total delay vs. operating time	36.1	34
% of total delay caused by traffic	17	17
% of total delay caused by signals	16	13

(Calculations based on delay, actual and idealized speed, in Ref. 27, Tt. III, XXVII.) It is probable that the combination of transit lanes and signal preemption will have a neutral or positive impact on air quality, by increasing transit ridership.

Overall, transit lanes with signal preemption really constitute primarily a strategy for reducing transit operating costs and providing faster service, rather than an air quality improvement measure. Although reduction of costs can have an effect on service frequency, with perhaps further, indirect air quality impacts, the emissions reduction can be expected to be a minor one.

Employer-Based Subsidized Transit Pass Program

In this strategy, SEPTA would sell its transit passes to area employers at a discount for an introductory period of one month, following which the employers would purchase the passes from SEPTA at the regular price and continue to subsidize employee pass purchases at the same rate, as an employee benefit. In one scenario investigated in a recent consultant study, SEPTA would offer an initial discount of $1.50 on the weekly pass and $6.00 on the monthly pass. Hence, after the first month, employers would sell the weekly pass (regularly $9) to employees at $7.50, and the monthly pass (regularly \$35) at \$29 (Ref. 1, pp. 4-40 to 4-54). This strategy would be beneficial to the transit operator, resulting in \$87,170 in additional revenues. It is estimated that in 1987, 394 additional trips per day would be generated, resulting in an HC emissions reduction of 1.9 kg/day.

Although the scheme described above would result in only a very small improvement in air quality, it is believed that further study, including a pilot project, would be necessary before the full potential of this strategy can be evaluated. As this would be a revenue-generator for the operator, it is likely that there will be further investigation of employer program, for economic reasons. Considering that future study may demonstrate a considerably greater level of emissions reduction, this strategy is a reserved measure.

Reduced Bridge Tolls for High-Occupancy Vehicles (PA and NJ)

This strategy would encourage the formation of carpools and vanpools by reducing the bridge tolls on Delaware River bridges for regular commuters who travel three or more in one vehicle. It would also discourge other drivers from making the crossing by increasing the tolls for vehicles other than those used for carpools. The toll modifications would have been made on all toll facilities between the Delaware Memorial Bridge at Wilmington to the Route 1 Bridge in Trenton. A specific proposal has been discussed in which pools would cross free on any bridge with the purchase of a 3-month sticker costing \$5, making the average toll about 4¢. Other tolls would be raised to a level where revenues were unchanged or greater than before the pool toll was instituted.

Meetings have been held with three of the five authorities involved (DRPC, BCBA and DRJTBC). In addition to the proposal, other strategies were discussed including one-way bridge tolls and raising tolls on the BCBA and DRJTBC to the levels of the DRPA. DVRPC staff prepared for an anlysis of the impacts of the proposed toll by analyzing the impacts of the then-present toll structure on the DRPA bridges which included a \$4 book of 40 tickets for carpools of 3 or more. Before these meetings and studies were concluded, however, it become clear that the proposal was unworkable.

Raising tolls on the non-DRPA bridge to DRPA levels appear to be impossible due to charter restrictions and, even if not, are improbable for political reasons. Eliminating or reducing the toll for carpools on 10¢ and 15¢ bridges have been agreed to be ineffective in encouraging carpool formation. In April, 1982 DRPA instituted new carpool rates at 40 tickets for \$16, a reduction of \$4. Considering the modest level of emission reduction likely to result from these rates, this strategy is placed on the list of reserved measures.

Synchronized Traffic Signals: Pennsylvania

There are about 45 TSM projects for synchronization of traffic lights on streets and arterial highways (many of these, however, apply to different segments of the same roads). These improvements allow a small improvement in air quality by minimizing intersection delay and accompanying idling by motor vehicles.

Individual synchronization projects allow only a relatively small savings in vehicular emissions; for this reason, these projects are placed on the reserved list of control measures.

Intersection Improvements: Pennsylvania

The TSM program for Philadelphia and the four suburban counties includes a large number of intersection improvement projects, mainly for the provision of turn lanes and signalling.

Turn lane improvements, comprising about 200 separate projects, entail widening of intersection approaches for the addition of turn lanes, channelization, restriping, provision of protected left turns, and lengthening of existing turn lanes. Most of these projects involve the construction of left turn lanes, although there are plans for a few right turn lanes and center lanes (continuous lane for left turns from either directions). At many intersections, curb cutbacks and increased turning radii (affecting mainly right turns) are planned (about 80 projects); and there are a few projections to realign intersections. Also, there are several projects to remove on-street parking at intersections to provide more room for turning movements.

The second major type of intersection improvement is the provision of left turn signals (sometimes incuding an advanced green phase), often coinciding with the addition of left turn lanes. There are about 70 projects for adding left turn phases; and some additional projects for refining signal timing and phasing, providing vehicle-actuated signals at secondary intersections, and removing underutilized signals.

It should be noted that many of these projects are intended to reduce unnecessary delays at intersections, with improved safety as an additional benefit. Turn lanes and accompanying signal phase and timing improvements will allow a small reduction in vehicular emissions by separating flows of through and turning traffic, preventing extended idling of vehicles which are delayed as a result. Realignment projects and curb cut-backs may reduce vehicle mileage slightly and allow higher speeds through intersections, while demand-actuated signals at minor intersections will reduce delays and extended idling for traffic on arterials as well as side-streets.

However, the emissions impacts of individual intersection improvements are very minor, and only in the aggregate will they allow a measurable reduction in air pollution.

Exclusive Southbound A.M. Peak Hour Bus Lane on Roosevelt Boulevard

In this project, a reserved bus lane would be provided on Roosevelt Boulevard for southbound buses operating between Adams Road and 9th Street, during A.M. hours only. The lane would be located on the curb side of the local lanes along the north side of the highway, and would facilitate movement of the Fox, J, R, and Boulevard Limited buses. In conjunction with this, there would be an improvement in bus loading and unloading facilities where the R and Limited buses cross the Broad Street Subway at Hunting Park Station, so that passengers would not need to walk across Broad Street: either a revised bus circulation plan with bus bays or turnouts, or a pedestrian tunnel bridging the subway tracks (Ref. 5).

The bus lane would result in an increase in total vehicle travel time and fuel consumption for cars and trucks using the local lanes by 2 to 3% although it would facilitate faster movement by buses. It would reduce HC emissions by .1 Kg/day CO emissionsby 3.8 Kg/day, and NOx emissionsby .6 Kg/day; although the daily HC emission reduction figure is very small, a greater savings would result if there is an increase in bus ridership and a corresponding diversion from private cars as a result of the improved bus operating speeds. Implementation would cost $92,000.

Considering the modest air quality gain resulting from this project, it is placed on the reserved list of air quality control measures. It may, however, be implemented during the reconstruction of the Frankford elevated line if this should result in an increase in bus service on the Boulevard to route passengers downtown via the Broad Street Subway.

Park-and-Ride Bus Service

In this project, five express bus routes serving nine park-and-ride lots would provide service from Pennsylvania suburbs to the Philadelphia CBD (Ref. 4, pp. 18-31). The following routes have been investigated in a preliminary analysis: (1) a Cargo City route, using I-95 and I-76; (2) a Valley Forge Park route using I-76; (3) a line serving Souderton Plaza, Montgomeryville Plaza, and English Village, via PA 309 and Broad Street; (4) a line serving Doylestown Center and Warrington Shopping Center, via US 611; and (5) a line serving Neshaminy and Red Lion Malls, via US 1 and Broad Street. Carpools and vanpools could also use these park-and ride lots as rendezvous. These routes would make heavy use of existing shopping plaza parking lots, to reduce parking lot construction costs; they would probably result in an increase in sales at participating shopping centers.

If all five routes were made operational, a 21.7 Kg/day HC emissions reduction would be possible, according to a preliminary estimate. However, this figure would be lowered considerably if the patronage on a number of parallel, existing bus routes and commuter rail lines were reduced. Although there may be considerable merit in introducing additional park-and-ride bus service in the Philadelphia suburbs, further analysis is necessary to delineate routes which will have a minimal impact on extant transit service. For this reason, the park-and-ride services as described are placed on the reserved list of air quality measures.

Seasonal Fare Reduction

In this project, there would be a reduction in adult cash fares and pass prices during July and August to encourage an increase in transit ridership on SEPTA's City and Suburban divisions during the period when most of the ozone violations occur. It would also allow better utilization of excess system capacity during the summer months when schools are closed (Ref. 1, pp. 4-54 to 4-63).

Although the actual seasonal fare levels would depend upon the regular year-round base fare prior to introduction of the new fare policy, if the base fare were $.70, summer fares would be lowered to $.50 and fares during other months would be increased to $.75. Under this scenario, a $9.00 pass would become $7.25 during the summer and $9.50 during the remainder of the year. To avoid an unfavorable cash flow problem, the fare would first be raised during the September preceding the initial low fare summer season, and the additional revenues would be banked.

This project would increase transit ridership by 20,940 during summer months, but cause a reduction in ridership by 9,348 trips/day during the remainder of the year. There would be an HC reduction of 106.4 kg/day in July, 1987 and a CO increase of 942 Kg/day in December of the same year.

Although start-up costs would be relatively small ($100,000 to $150,000), and there would be fewer seasonal scheduling changes required, the operator would experience some serious operational and administrative problems in implementing this strategy. Also, it is believed that there would be considerable public resistance to regular fall fare increases. For these reasons, the seasonal fare reduction strategy is placed on the reserved list of measures.

Rehabilitated Light Rail Vehicles

In this project, 148 all-electric PCC cars, dating from 1947 and 1948, would be thoroughly rehabilitated to extend their useful life by eight years (Ref. 25, p. 19, Ref. 26, p. 42). This would improve both the aesthetics and reliability of the cars. This project, which is already underway, is an alternative to the purchase of new light rail vehicles for the North Philadelphia routes (allowing the replacement of all PCCs still in operation), which would allow a somewhat greater air quality benefit than the rehabilitated cars in 1987. If new cars are not purchased, and it is decided to convert the Philadelphia surface car lines to another mode, the rehabilitated PCCs would still be in service in 1987, resulting in a reduction in HC emissions of 5 Kg/day. Considering the uncertainty over the operational status of these cars in the target year, and the relatively small air quality benefit, this project is placed on the list of reserved measures.

New Light Rail Vehicles for North Philadelphia and the Norristown Line

In this project, 21 new light rapid transit vehicles would be ordered to provide service on the Norristown High-Speed Line in 1985. These cars would replace the Strafford and Bullet cars (now 56 and 50 years old, respectively), thus improving comfort and reliability of service on the P & W Division. Also, new light rail vehicles would be procurred for the North Philadelphia streetcar lines, becoming operational in 1987, with similar benefits. Altogether, the air quality benefits from these car orders would beless than 10 Kg/day HC emissions reduction.

It is presently undercertain whether the North Philadelphia car lines will be retained as light rail or will be converted to trackless trolley or diesel bus; this makes it impossible to make a commitment to the additional car order in 1987. In the case of the Norristown Line cars, there is uncertainty over funding for replacement vehicles. For these reasons, this project is placed on the list of reserved measures.

NEW JERSEY

New Bus Routes: New Jersey

A number of new bus routes have been proposed in the TSM plan. These include express service to Camden and Philadelphia along NJ Routes 543 and 70 in Camden County, express service along NJ 70 from Medford/Evesboro to Philadelphia and a new intra-county bus route in Burlington County, and express service from Kim Valley to Trenton in Mercer County. In addition, a recently consultant study recommended the following new routes in Mercer County: a route to Fernwood, a Prince-Hightstown route serving Quaker Bridge Mall, and an Independence Mall route. These latter routes would allow an HC emission reduction of 3.58 kg per day (Ref. 3, pp. 186, 260-261, 294). These new bus routes would require a substantial increase in operating subsidies, which may be difficult to provide in light of expected cutbacks in federal operating funds for transit. Also, the expected level of emission reduction is rather small.

Improved Bus Service Frequency and Route Modifications: New Jersey

NJ Transit is currently in the process of modifying (in some cases extending) a number of routes in Camden, Burlington, and Gloucester counties. Changes have been made on Routes E, H2 (now H), L, M, R, and Z (with routes N and H1 being discontinued) in January, 1982, on Route V in April, and on Route F service in June 1982. A number of other potential route changes are also under study.

The TSM plan includes a number of proposals for increase in peak hour bus service, including corridor service along NJ highway routes 30, 70, 168, and 543 in Camden County, Route 50 Mount Holly in Burlington County, and Routes 41/47 and 45 in Gloucester County. There are also a number of projects to improve bus schedules for much of Camden, Burlington and Gloucester counties.

In Mercer County, a recent consultant study recommended modifications of bus routes G, P, Q, R, and T resulting on a total HC emission reduction of 0.49 kg/day. Some route changes have a negligible impact on HC but would allow a CO emissions reduction (Ref. 3, pp. 187, 255, 261-265, 294).

Minor route changes may be implemented rather easily; however, improvements involving route extensions and increases in service frequency would require an increase in operating subsidies, and may be more difficult to implement in a climate of reduced federal operating subsidies for transit. (In a few cases, it is possible that bus emission reduction resulting from eliminating greatly under-utilized transit routes might be greater than the increase in auto emissions resulting from cessation of service, resulting in a slight emissions reduction.)

Overall, the air quality benefits of these changes, should they be implemented, are expected to be very small.

Bus Shelters: New Jersey

In this project, bus shelters would be installed throughout the state, increasing the comfort associated with bus travel. In the DVRPC region, 32 locations would receive shelters in Camden County; Burlington County may install a dozen shelters. and Gloucester County intends to install 61 shelters. As most of the sites recommended for shelters are in highly visible, populated locations, they should be effective in attracting riders.

This project would result in a ridership increase of 242 per day, with an HC emissions reduction of 1.4 kg/day in 1987 (Ref. 2, pp. 108-109). Despite the very minor level of air quality improvement, this project is relatively inexpensive, with a capital cost of only $280,000. Therefore, it is placed on the list of reserved measures.

Bus Stop Signs and Marketing Program: New Jersey

In this statewide project, signs would be installed at bus stops in order to improve the visibility and marketability of the transit service. A total of 134 signs have been allocated to Camden County, and 59 to Burlington County; Gloucester County may request 19 signs. In addition, a statewide bus marketing program is included, in which a multi-colored, tri-county transit guide would be developed, printed, and distributed.

This project is expected to generate 97 new riders per day. The HC emissions reduction in 1987 would be 0.5 kg/day (Ref. 2, pp. 105-107). Despite the very minor level of emissions reduction, the project is very inexpensive, with a capital cost of only $100,000. Therefore, it is placed on the list of reserved measures.

Bus Stop Relocation: New Jersey

The TSM program includes over 15 projects to relocate bus stops to the far sides of intersections in Camden and along the ROute 168 corridor, and about 15 additional bus stop relocation projects in Camden County. There are also some additional far-side bus stop projects in Mount Holly and elsewhere in Burlington County; along NJ Route 41/47 and 534 in Gloucester County; and in the NJ Route 206/524 area in Mercer County. Finally, there is an area plan for off-street bus bays along the Route 168 Corridor in Camden County.

Far-side bus stops allow buses to drive around right-turning traffic which may prevent them from gaining access to near-side stops; this allows bus service to be speeded up, and should result in a very small diversion from private cars to transit. Curb-side bus bays allow buses to pull off main thoroughfares to make their stops, allowing less interference with other traffic, and a slight reduction in automobile and truck emissions. The air quality benefits from these bus stop improvements are expected to be very small. Therefore, this strategy is placed on the list of reserved measures.

Coordination of Transit Service: New Jersey

The TSM plan includes projects to provide additional bus feeder service to PATCO, including a park-and-ride express bus along the Route 168 corridor from Audubon to the PATCO Broadway station, and for mode-change scheduling for local buses in the Camden area. For Burlington County, there is a project to establish a PATCO feeder bus along Route 73. Finally, a recent consultant study has recommended that an information display case be erected at the downtown rail station in Trenton, showing bus routes and schedules connecting the station with the Trenton CBD (Ref. 3, pp. 234-235, 244-245, 294).

These projects would provide better inter-modal connections, with reduced waiting time (and hence reduced total trip time) for transit users. It is expected that the increase in the number of home-to-work trips generated by these projects would be relatively minor. However, in the suburbs, some park-and-ride commuters may switch to the bus as an access mode to the Hi-Speed Line, with a small reduction in VMT of auto travel per rider. Overall, the emissions reduction allowed by improved coordination of transit service will be relatively small.

Discounted Multi-Zone Monthly Pass Program: New Jersey

In this project, a monthly pass program would be implemented that would allow NJ Transit passengers a discount on trips which extend through more than one zone. This could complement the extant discounted-one-zone monthly pass. It is assumed that the current average fare of 75¢ for multi-zone trips would be reduced to 72¢ with the new pass program.

The discounted mutli-zone pass would increase the convenience of transit use by allowing passengers to merely show their pass upon boarding, without the need to carry around a considerable amount of change; it would reduce commuter costs slightly, and encourage additional transit use as it is possible for pass-holders to make an indefinite number of trips per month. There are also some advantages to the transit operator, as the pass program allows prepayment of fares, with lower expenses for cash handling, and the posibility of collecting interest on the money paid in advance. Finally, it would allow a slight reduction in delays upon boarding as passengers queue at the farebox, with a small reduction in platform costs. These factors, together with the revenues from new ridership generated, can help to offset the loss of gross revenue as fares are effectively lowered for existing patrons, many of whom would switch to the pass.

This project would generate 259 new riders per day, allowing HC emissions reduction of 1.4 kg/day in 1987 (Ref. 2, pp. 132-134).

HOV Lanes on US 130

In this strategy, High Occupancy Vehicle (HOV) lanes would be set up along the US 130 corridor in western New Jersey, from Burlington to Westville. Access to the HOV lanes would be limited to vehicles with three or more occupants. The HOV facility would take the form of with-flow median lanes. A preliminary analysis (Ref. 6) indicates that it may be possible to achieve a 49 kg/day HC reduction on the portion north of US 30, and an 89 kg/day reduction south of this point.

A detailed engineering and design study of US 130 is required before a definite recommendaiton can be made for HOV lane treatment of this corridor. Traffic lanes are narrow on certain portions of Route 130, raising safety questions (and possibly requiring widening of the highway); and there are numerous intersections, including several traffic circles, whose layout would need to be studied in some detail.

Because of the need for a detailed engineering study, the HOV lane alternative for Route 130 must be placed on the list of reserved measures. Future consideration may be given the project if it is determined that (1) the HC emission savings are as substantial as indicated in the preliminary study, and (2) all safety questions have been answered.

PATCO Extension to Berlin-Atco

In this project, the extant Lindenwold Hi-Speed Line would be extended to Atco, along the Route 30 corridor, a distance of 7 miles. This project would provide rapid transit service along an important segment of a major travel corridor between Philadelphia and Atlantic City, and would help to alleviate traffic congestion in Berlin, the first major town east of Lindenwold on Route 30. The extension would generate a 600 per day increase in ridership, resulting in a 10.5 kg/day HC reduction in 1987 (Ref. 2, pp. 115-116). This project would require a considerable capital expenditure ($77 million) for implementation. Considering the uncertainty of funding a the present time and the modest benefits to air quality, the Berlin-Atco extension is placed on the list of reserved measures.

PATCO Extension to Maple Shade and Bellmawr

In this project, two PATCO branches would be constructed, from Broadway Station in Camden to Maple Shade and Bellmawr, totalling 11 miles. This would provide rail rapid transit service to a large area of western New Jersey which is presently served only by buses. The extension would generate a ridership increase of 7917 per day, resulting in a 75.4 kg/day reduction in HC emissions in 1987 (Ref. 2, pp. 113-114). The great expense of the project ($71.8 million), and the uncertainty of funding and implementation before 1987 suggest reserving this measure.

Reduced Bridge Tolls for High-Occupancy Vehicles (PA and NJ)

See discussion under PENNSYLVANIA

Synchronized Signals: New Jersey

Signal synchronization would allow a general speed-up of traffic movement on affected highways, minimizing intersection delay. In Trenton, in Mercer County, there are plans to synchronize signals on Broad, Montgomery, Hanover, and Warren, for traffic light interconnection along Broad Street, and to update signal timings at 24 additional intersections (Ref. 3). In addition, in Camden County, there is a TSM project for areawide synchronization along Route 30.

Considering the relatively small savings allowed by most of these individual projects, this strategy is placed on the reserved list of control measures.

Other Intersection Improvements: New Jersey

The TSM program for the four New Jersey counties includes a large number of intersection improvement projects, mainly for the provision of turn lanes and signalling.

Turn lane improvements, comprising at least 45 separate projects, entail widening of intersection approaches for the addition of turn lanes, channelization, restriping, and provision of protected left turns. Many of these projects involve the construction of left turn lanes, with plans for a few right turn lanes and center lanes (continuous lane for left turns in either direction). At a number of intersections, curb cutbacks would be provided (about a dozen projects).

Another major type of intersection improvement is the provision of left-turn signal phasing (about 20 projects). In addition, there are a few projects to improve traffic circles, with better approach design, channelization, signal phasing, and metered signals; to prohibit crossovers and left-turns, and to eliminate encroachment at intersections by relocating and restricting side street access.

It should be noted that many of these projects are intended to reduce unnecessary delays at intersections, with improved safety as an additional benefit. Turn lanes and accompanying signal phase and timing improvements would allow a small reduction of vehicular emissions by separating flows of through and turning traffic, preventing extended idling of vehicles which are delayed as a result. Curb cutbacks may reduce vehicle mileage slightly and allow higher speeds through intersections. Traffic circle improvements would reduce traffic tie-ups where free-flow access to circles is rendered ineffective by excessive congestion. Finally, turn restrictions would eliminate congestion caused by turning vehicles blocking intersections (while adding somewhat to circuity of travel for the turning vehicles).

The emissions impacts of individual intersection improvements are very minor, and only in the aggregate would they allow a marked reduction of air pollution. For this reason, these projects (other than those recommended in the CO Hot Spot Study) are placed on the reserved list of control measures.

Camden Transportation Center

In this project, a multi-modal transportation center would be established in Camden's downtown urban renewal area. This would include renovation of the PATCO Broadway Station, a centralized bus terminal for NJ Transit and other buses at the PATCO station, parking spaces for several hundred vehicles and construction of leasable office and retail space.

Under the assumption made about the terminal's proposed features, this project would improve the attractiveness of the Broadway Station as a transfer point, and generate 137 additional riders per day. The resultant HC emissions reduction in 1987 would be 0.7 kg/day (Ref. 2, pp. 103-104). Considering the cost of the project ($21 million), and the very small reduction in emissions, this strategy is placed on the reserved list of air quality improvement measures.

Parking Measures to Encourage Ridesharing by State Workers

In this project, there would be a reduction in parking available to state workers, restricting parking spaces to use by only 30% of the employees for all new state office buildings in the Trenton CBD. In addition, 50% of all existing and future state-owned or leased parking spaces in the CBD would be designated for high-occupancy vehicles only; and finally, a $1 daily parking fee would be charged at CBD parking lots for workers commuting in vehicles with less than three people (two occupants for subcompacts). Non-ridesharing spaces would be designated by a combination of seniority and a lottery system (Ref. 3, pp. 232-233, 242-243, 258-259, 293).

These measures, if all enacted, would result in a 65.6 Kg/day reduction in HC emission in 1987. Some 924 of 2250 parking spaces needed for three new buildings would not be required; this would result in a savings of $111,000/year. Revenues from parking fees would raise an additional $684,000/year, which would cover the $17,000 start-up costs and $26,000 annual O&M costs for the program; this would leave an additional $767,000 in operating revenues, which could be used to fund other local air-quality projects and/or to provide some tax savings. As a result of the parking measures, 3,312 parking spaces could be made available for other long or short term parking by other CBD workers, shoppers, or visitors, or the land could be made available for other purposes. There also would be a small improvement in peak hour travel time for CBD drivers due to reduced congestion.

NJDOT supports these parking measures conceptually; but is not prepared to make a commitment until Phase III of the Trenton Area Study is complete. If at this time specific measures are found to be feasible (and provided there is statutory authority to proceed, or that it can be obtained through new legislation), they will be implemented. For this reason, this project is placed on the list of reserved measures.

Use of State Pool Vehicles for Carpools

In this project, the state pool vehicle fleet would be used for carpools, to allow workers from Mercer County and surrounding areas to commute to state office buildings in Trenton. Users would be charged a mileage fee to cover the added fuel and maintenance expenses incurred; participants would be limited to workers who have no access to mass transit (Ref. 3, pp. 234-235, 243-244, 294).

There would be an HC emissions reduction of 15.7 Kg/day in 1987 if this project were implemented. 1,056 fewer parking spaces would be required in the Trenton CBD, allowing a reduction in parking lot construction costs. There would be an increase in O&M costs of $436,000 per year, which would be met by an 11¢/mile user charge.

NJDOT supports this proposal conceptually, but is not prepared to make a commitment until Phase III of the Trenton Area Study is complete. If at this time the project is found to be feasible (and provided there is statutory authority to proceed, or that it can be obtained through new legislation), it will be implemented. For this reason, it is placed on the list of reserved measures.

State Leasing of Vans for Employee Ride-sharing

In this project, the state would lease 20 vans of thirteen-passenger capacity for use by vanpools from points in Mercer County and surrounding areas to state office buildings in Trenton. The driver would be provided with free transportation, with other vanpool commuters paying a monthly fare that would cover the cost of purchasing, operating, and maintaining the vans (Ref. 3, pp. 88-89, 100-101, 111).

This project would allow an 8.1 Kg/day reduction in HC emissions in 1987. It would allow a reduction in parking lot construction costs, allowing some tax savings; and would free urban land for more productive purposes.

NJDOT supports this proposal conceptually, but is not prepared to make a commitment until Phase III of the Trenton Area Study is complete. If at that time the project is found to be feasible (and provided there is statutory authority to proceed or that it can be obtained through new legislation), it will be implemented. For this reason, it is placed on the list of reserved measures.

Park-and-Ride Express Bus Service for Trenton

In this project, a number of express bus routes would be established in the Trenton area, mostly utilizing shopping centers for park-and-ride lots. As many as four trips would be made per route per peak hour period, being scheduled to match state employee working hours (Ref. 3, pp. 229-233, 239-241, 293). Eight routes have been evaluated on a preliminary basis, as follows. Three routes would serve points entirely within Mercer County: (1) a Princeton route, with a parking lot at the Princeton Shopping Center or at the University; (2) a line to Hopewell and Pennington Shopping Center, via Route 31; and (3) a line to Hightstown (possibly using the Twin Rivers Shopping Center) and to Hamilton Shopping Center in Hamilton Square. Four routes would extend into other New Jersey counties; (4) a line to Newark and New Brunswick, via US 1; (5) a line to the Monmouth Mall at Eatontown, and to Freehold (using park-and-ride lots serving New York buses); (6) a line to Ewanville and Mansfield, via Route 206; and (7) a line to Edgewater Park and Bordentown, via US 130. An eighth route would extend into Pennsylvania, following US 1 to Fairless Hills Shopping Center and Williamson Park, near Morrisville.

If all eight routes were placed in operation, there would be an HC emission reduction of 51.4 Kg/day in 1987. Fifty-four new buses would be utilized, costing $10.8 million; as fares would provide only $946,000 yearly, a subsidy of $463,000 would be required (possibly from parking fees and saving from not constructing new parking lots) to cover the annual O&M costs of $1.4 million.

NJDOT supports this project conceptually, but considers it premature to make a commitment until Phase III of the Trenton Area Study is completed, At that time, if specific routes are judged to be cost-effective, they will be placed in operation. For this reason, this project is placed on the list of reserved measures.

Shuttle Service Between State Offices

In this project, three shuttle routes would carry state employees between state office buildings by bus, reducing the use of state cars for official business. The following would be established: (1) a route serving state office buildings in the Trenton CBD, on a 30-minute headway; (2) a route to Newark via Route 1, running four times a day on a three-hour headway; and (3) a route to Cherry Hill, Camden, and Atlantic City, running three times a day, on a three-hour headway (Ref. 3, pp. 234-235, 245-248, 294).

This project would allow a reduction in HC emissions of 11.6 Kg/day in 1987. It would result in a decrease in the size of the state vehicle fleet, eliminating the need for 176 "pool" and 431 "fleet" vehicles, with a $925,000 savings in maintenance, gasoline, personnel, and vehicle replacement costs; in addition, there would be other savings resulting from reduced parking lot construction. These savings would more than cover the $70,000 cost for seven 13-passenger vans needed to provide the service, and the $164,000/year O&M costs.

NJDOT supports this project conceptually, but considers it premature to make a specific commitment until Phase III of the Trenton Area Study is completed. At that time, if the project is judged to be cost-effective, it will be implemented. For this reason, it is placed on the list of reserved measures.

APPENDIX B

Rejected Strategies (See Section 2.3)

SEPTA Rapid Transit and Commuter Rail Vehicle Overhaul

In this SEPTA project, 250 Market-Frankford line rapid transit cars would be thoroughly overhauled, involving improvements to the trucks, control, pneumatic and heating/ ventilation systems, carbody, and seating (Ref. 26, p. 41). Also, the 20 GSI-built Silverliner commuter railcars would be modified with changes in the truck frames, brakes, suspension, and propulsion system (Ref. 25, p. 24; Ref. 26, p. 50).

This project would result in no additional ridership, as the changes would be almost imperceptible to riders (Ref. 1, pp. 2-20 to 2-23); hence, there would be no air quality benefits.

Electrification of Rail Lines

Electrification of rail lines would entail the installation of overhead catenary, transmission lines, etc., to allow operation of multiple unit electric commuter trains on branch lines which would otherwise have to be serviced by diesel rail cars or locomotive-hauled trains. This would allow a small improvement in running time (as electric cars generally have better acceleration), less noise, and elimination of diesel fumes, which contain benzopyrene, a suspected carcinogen.

Electrification would be one means of providing through service into the CBD, using the Center City Tunnel in which diesel fumes could not be tolerated; it would allow the elimination of a transfer from diesel rail car to Silverliner train where the branch joins an electrified line. Diversion from autos would be very small for lightly-traveled branch lines, except in cases where commuter trains were not previously running on the branch.

The only railroad electrification project which was included in the Year 2000 Plan was the Newtown Branch which was included in the 1979 SIP Revision but has subsequently been dropped from the Transportation Improvement Program. For the other commuter rail lines in the Year 2000 Plan (the Octoraro and Stony Creek Branches and New York Short Line), implementation by 1987 is doubtful and the technology to be used is undecided.

Considering the recent cutback on commuter rail service, including elimination of longer haul diesel trains which had operated into Reading Terminal, further electrification at this time appears unlikely. The emphasis over the next few years will be upon preserving existing lines.

It seems likely that future extension or resumption of service on branch lines would utilize modern self-propelled cars like the SPV-2000 or the Leyland Railbus, at much lower capital cost for a lightly-used line, albeit requiring a transfer. A vehicle with a dual-mode, diesel-electric/electric power plant, and which could operate under its own power or under overhead wires, might be a better solution for branch lines, allowing the transfer to be eliminated. (No such vehicle is presently available; however, gas turbine-electric/electric cars, based on Silverliner and Metropolitan commuter rail cars, have been tested on the Long Island Railroad.)

SEPTA Rapid Transit and Light Rail Infrastructure Improvements

In this project, improvements would be made on signal, communication, and control cables for the Market Street, Broad Street, and Ridge Avenue subways; and substations would be replaced and renovated on the rapid transit lines and on the Media-Sharon Hill and Norristown light rail lines. Other improvements include new switches, track, third rails, poles, and overhead on rapid transit and light rail lines (Ref. 25, pp. 12, 18; Ref. 26, pp. 39, 43-45).

This project would have no impact on ridership, as the effect on service would be imperceptible to passengers (Ref. 1, pp. 2-20 to 2-23).

PATCO Infrastructure Improvements

In this project, a number of improvements would be made on PATCO's system infrastructure, including the reconstrucion of the trackbed on the approach spans on either side of the Ben Franklin Bridge, replacement of seat cushions on the rapid transit car fleet, replacement of substation circuit breakers built in the 1930s and of an auxiliary power source, the acquisition of a bridge crane and a self-propelled crane car, and the construction of a test track.

Most of these improvements would have no impact on ridership (Ref. 2, pp. 119-121); seat cushions might be perceptible to patrons, although PATCO already has an image of running clean, comfortable, well-maintained trains. This strategy is expected to have no air quality benefits; therefore, it is placed on the list of rejected measures.

Differential Peak/Off-Peak Fare Structure

In this strategy, a higher fare would be charged during peak hours and a lower fare during off-peak periods on area buses, trolleys, and rapid transit lines, similar to the peak and bargain fares used on the commuter rail system. Differential peak and off-peak fares would discourage unnecessary riding during rush hour, and encourage shoppers and other non-commuters to make their trips during slack periods of the day, providing more space for rush hour commuters. This would allow better equipment utilization and manpower use by the transit system, reducing the need for extra transit vehicles and for additional operators, who are needed only for a few hours per day. In some cases, where buses are greatly underutilized during off-peak hours, it may be considered desirable to reduce off-peak fares to induce additional ridership and avoid the negative image created when nearly empty buses are seen on the road. In the latter cases, it may be used as a marketing device to introduce new riders to the system.

In a discussion of reduced off-peak fares, Issue Paper 2 has estimated that a 25% reduction in fares during off-peak hours (holding peak fares the same) would result in a 40,000 per day ridership increase on Pennsylvania city and suburban transit lines, and a 3700 per day increase in New Jersey (corresponding to a 550 kg/day and 57 kg/day reduction in HC emissions, respectively). These increases in ridership, of course, would not occur during the 6 to 9 a.m. period which is most critical in the formation of ozone from HC emissions.

However, in this scenario, ridership would increase by only 8.3% which would not be enough to balance the loss in revenues from existing riders who would also benefit from the lower fares. It is suggested that peak hour fares would have to be raised to compensate for this, as the present climate for increasing transit operating subsidies is not favorable at either the federal or local level. An increase in fares during peak hours would result in lower ridership; it would not be necessary to raise enough fares to replace all of the lost off-peak revenues, however, because there would be some savings in capital replacement and especially operating costs, as a result of the reduced peaking factor. On bus and trolley lines, there would also be a reduction in the number of runs per hour, increasing waiting time and making the system less attractive to some users; this would of course result in a further reduction in peaking and greater operating economies (it is assumed that for rapid transit, train length would be shortened, with little impact on level of service). It is apparent that a small increase in peak hour fares would have marked impacts on patronage, costs, and revenues.

Although it might make sense from an economic viewpoint to charge a higher fare during rush hour, discouraging extreme peaking in ridership, the fact remains that it is the ability of mass transit to handle very large crowds during peak periods that makes it so valuable as an air pollution control measure. Considering the general lack of congestion and pollution pricing of private transportation, it appears to be advantageous for urban areas to invest in excess transit capacity, to avoid excessive clogging of streets and highways. Hence, there are valid environmental reasons for avoiding increases in peak hour fares, and for encouraging as many commuters as possible to ride the buses and railcars, and leave their automobiles at home during peak periods.

It should be noted that reduced off-peak fares, if achieved without raising peak fares, would be a marginal air quality control measure, though much less effective than measures which divert peak hour ridership. However, although it is possible to drop off-peak fares while initially holding peak hour fares constant, it is likely that during subsequent fare increases (which are inevitable in periods of inflation), peak hour fares would eventually be raised to a higher level than would have been the case with a day-long uniform fare. Unless peak hour fares are held constant with respect to an economic indicator such as the cost of living index (which is difficult to accomplish in view of the fact that transit labor, construction and energy costs may not increase at the same rate as the CPI), it is probable that what is initially a reduced off-peak fare strategy will evolve into a differential peak/off-peak fare structure, with increasing peak hour fares, as described above.

The advantages and disadvantages of differential peak/off-peak fares will of course vary depending upon the situation of the individual transit operator, and the market served. In this area, such a fare policy would be especially disadvantageous for the SEPTA City Division, which has especially heavy off-peak ridership and could suffer a considerable loss in revenues if off-peak fares were lowered. It is also unlikely that a reduced off-peak fare policy could be implemented on the suburban Red Arrow Division, for equity reasons, and because RAD fares are interlocked with those of the City Division. On the other hand, there may be better economic justification for reduced off-peak fares in the New Jersey suburbs, where it is perceived that there is considerable excess capacity on buses during off-peak hours. Even here, however, it is doubtful whether there any air quality benefits, and depending upon the impact of lower off-peak fares on overall revenues and on peak hour fare policy, there might very well be a negative impact on air quality.

It is believed that the seasonal reduction in transit fares described elsewhere in this report would be a much more useful air pollution control measure, as it would be targeted at the summer period, when the ozone problem is maximal, and would not discourage rush hour ridership during the implementation period. If a reduced summer fare should be adopted on a transit system which also has a fall-winter-spring peak/off-peak fare differential, it is suggested that the summer fare be the same as the off-peak fare during the remainder of the year, to minimize confusion by system users, and simplify fare collection for the operator.

Free Intra-CBD Bus Rides on All Regularly-Scheduled Buses

This proposal would allow any rider to board regular buses within the CBD, free of charge. This would encourage people who might otherwise drive within the center city area to use transit for short trips. DVRPC staff estimates based on an elasticity of 22% with respect to fares suggest that a proportional increase in ridership could result from the 100% decrease in fares. If all of these new riders were diverted from cars, this would mean a small (4.4 kg/day) emissions reduction.

Of course, many of the people diverted would be those who presently walk within the CBD area, where residents as well as commuters do not tend to make many local trips by private car. It is probable that the number of riders induced would be great enough to cause extreme crowding of buses; and the loss of fares from the 25,000 extant fare-payable CBD riders would be a negative economic impact. It is possible that such a strategy would have to be limited to off-peak hours, to avoid additional crowding during rush hour.

The main reason why this strategy would be unworkable, however, is that it is incompatible with the present fare collection system. In order to avoid loss of fares when commuters board buses upon leaving the downtown area, it would be necessary to institute pay-leave fare collection on all outbound buses (with pay-enter only on inbound vehicles). This would increase loading and unloading time, as the center doors could no longer be used by exiting passengers, and there would be extreme congestion in the aisles and under-utilization of standing-room in rear of buses as all passengers enter and exit the front door. This would increase travel time, resulting in the loss of some paying riders and an increase in platform costs.

A limited application of the CBD fare-free concept would allow free fares only on inbound buses which terminate downtown, to avoid a loss of fares on outbound runs, i.e., for eastbound trips on east-west routes. North-south lines would not be included in this scheme, as they do not terminate downtown. In all probability, many users would ride the free bus in one direction and walk back, to avoid paying a fare. Even this limited fare-free operation would have drawbacks: it could divert a number of riders from subway and subway-surface lines, and probably increase the noise and air pollution caused by surface bus operation in the CBD area (fare-free rapid transit in the CBD is not possible without a barrier-free, self-service or "honor" fare collection system).

Although a limited fare-free downtown bus operation might serve to introduce some new riders to the system (e.g., auto commuters who might use the bus at lunch time), this would be a very expensive way to accomplish this end; fare-free days or other time-limited marketing devices would serve this promotional purpose in a more cost-effective manner. The disadvantages of this strategy far outweight the small and uncertain gain in emission reduction.

Transit Fare Prepayment for SEPTA Transit System

In this project, marketing methods for prepayment plans would be improved in 1981. This is expected to have only a negligible impact on ridership, as previous efforts to market the weekly and monthly transit passes have already achieved sufficient market penetration, such that very few new riders would be attracted by an expanded effort. Any further gains are expected to come from employer-based subsidized pass programs (see Reserved Measures). As there would be no associated emissions reduction from non-employer-based market programs, this strategy is placed on the list of rejected measures.

SEPTA Rapid Transit and Light Rail Fare Collection System

In this project, a new fare collection system would be installed at rapid transit and subway-surface stations, replacing outmoded existing equipment at these locations (Ref. 25, p. 44). This project would have only a negligible impact on ridership (Ref. 1, pp. 2-20 to 2-23); hence, there would be no resultant emissions reduction.

Replacement of PATCO Station Ticket Vending Equipment

In this project, the automated ticket vending equipment presently used at PATCO stations, which has experienced an increasing incidence of breakdowns in recent years, would be replaced with new, highly reliable equipment. This project would have only a negligible impact on ridership (Ref. 2, p. 122).

Improved Management - Labor Relations

In this strategy transit strikes would be averted by securing agreements between management and labor unions to binding arbitration. At present, strikes are common at the expiration of existing labor contracts. The benefits of improved management-labor relations include the avoidance of the extremely heavy automobile use which occurs during strikes, and the drop in transit ridership which is experienced immediately after the strike and may persist for some time thereafter.

The air quality impacts of such a strategy are hard to quantify as each strike may last a greater or lesser period of time, and it is very difficult to predict how much ridership will be lost as a result. SEPTA City and Red Arrow Division contracts expire during the spring; the worst strike impacts seldom affect the critical summer air pollution period. Lingering, reduced ridership may, however, have an impact on summer air quality.

Binding arbitration may be desirable, but it may be difficult to convince the concerned parties to agree to this on the basis of air quality benefits alone. More pressing reasons for strike avoidance would be loss of operating revenues and transit workers' incomes, loss of sales by CBD merchants, and the tremendous inconvenience to commuters. It is likely that binding arbitration would require action by state legislatures.

Pending action by SEPTA to take over the commuter rail system will undoubtedly involve work rule changes to improve labor productivity, which may be opposed by organized labor. Lowering of operating costs on the regional rail system to allow service to be maintained will have a very important and lasting impact on air quality, regardless of possible adverse impacts on management-labor relations.

Considering the minor and uncertain benefits from implementing this strategy, and the institutional problems in the face of present realities, improved management-labor relations must be rejected as an emissions control strategy.

Demand-Responsive (Dial-a-Ride) Service

In a dial-a-ride operation, the user is picked up on demand and delivered to a transportation "hub" or other activity center picked up at the hub and delivered to a destination on demand or picked up and dropped off on demand within a specified area. A taxi, van, or mini-bus used, and the use of the vehicle is shared with other riders.

Dial-a-ride can be used in urban, suburban, and rural parts of the region; it may be operated all day, or only during the off-peak hours, functioning as a shuttle bus on fairly regular routes during peak periods. Although it is especially useful as a means of increasing the mobility of the elderly and handicapped, it can divert some choice riders from cars (especially where fixed route service is poor) and can relieve parents from the need to shuttle minors around by car, reducing the number of unnecessary trips.

Dial-a-ride service is very expensive to provide when it is intended as a rapid-response (under thirty minutes) system for transporting commuters, as there may be considerable route circuity, and vehicle occupancies are low. It may, on the other hand, mean an economical solution to the elderly and handicapped transportation problem, incorporating some subscription service, rides arranged the previous day, and same-day calls with waits of up to several hours, with service to different areas on alternate days in some cases, to allow optimized vehicle routing and higher vehicle loads.

It is not an energy-efficient mode. According to a Congressional Budget Office study, dial-a-ride vehicles of van size obtain seven to nine miles per gallon, lower than most automobiles. The same type of van with a seating capacity of 12 may attain a vehicle occupancy of eight to 11 passenger miles per vehicle mile when operating as a van pool, but only one to 2.9 passenger miles per vehicle mile when used in a dial-a-ride service. The same study indicates that dial-a-ride is the most energy-intensive form of public transportation (after the taxi-cab): it requires 9200 BTUs per passenger mile for operation, almost as much as for older, less energy-efficient autos at 11,000 BTUs per passenger mile, and much more than for van pools at 1560 BTUs per passenger mile and various conventional public transit modes at 2600 to 3700 BTUs per passenger mile. The CBO report suggests that dial-a-ride is counter-productive in terms of energy consumption (Ref. 22, p. 47; T. 79, p. 35).

The above suggests that little, if any, air pollution savings are likely to result from increased use of dial-a-ride. In Trenton, where a demand-responsive service is provided for the elderly and handicapped, a recent consulting report indicates that expanded service would result in a .27 kg/day emissions increase (Ref. 3).

Dial-a-ride service may have a slightly negative impact on air quality if it generates a considerable number of new trips by the transportation disadvantaged, as vehicle mileage will increase. This impact may be reduced if it is properly coordinated with existing transit services (e.g., when the hub is a rail station) and a number of choice riders can be attracted, eliminating cold starts when park-and-ride commuters are diverted and also running emissions when previous auto-commuters are attracted to transit by the direct pickup/drop off at the front door at the home end of the trip (of importance mainly during night hours). The emissions impact might be neutral or even slightly positive if the mini-buses operate on regular routes with some route deviation, check point service, etc. during peak hours; (but this is a hybrid operation between dial-a-ride and regular feeder bus operation, not a dial-a-ride strategy per se).

Dial-a-ride in one or another form may be desirable for reasons of improved mobility to some segments of the population, and should not be discouraged where it is possible to find adequate funds for its operation. However, it appears to have little if any demonstrated air quality benefits.

Subscription Feeder Service to Transit Stations

This strategy involves the use of high-occupancy vehicles, usually vans, to carry people from home to a transit station, and from the station to home on the return trip; or between a transit station to a work place not adequately served by transit. A transit operator, apartment building, or employer might sponsor either kind of service or a group of commuters might provide their own vehicle and driver for a home-end shuttle. In the case of an employer-end shuttle, a driver would be provided by the sponsoring agency.

For the most part, this mode would provide service to the elderly, handicapped and people who cannot afford to buy a car. Although it could divert some park-and-ride commuters, it has the disadvantage of reducing the flexibility of service to one round trip per day (or per work shift), like ride-sharing, with the added inconvenience of a transfer and additional waiting time at the transit station. Also, although it will impact both cold start and running emissions, the reduction in air pollution may have little impact on the critical highly-urbanized portion of the region.

The only auto-owners likely to use such a service at the home end of the trip are those who live in the same neighborhoods, have roughly the same work schedule but commute to various points in the city, and have a relatively long drive to the rail station. The majority of short-distance commuters who drive to transit stations will prefer to maintain their flexibility of travel, which is the major attraction of the park-and-ride multi-modal combination. Drivers who are prone to participate in ride-sharing programs as a means of cutting travel costs are likely to use their carpool or vanpool for the entire home to work trip, and will not favor the extra inconvenience and expense of a transit ride.

Issue Paper 2 estimated that a relatively small savings in emissions of 21.5 kg/day would result if 10% of area rail patrons used such a subscription service. As it is unlikely that the actual capture rate, even with an extensive marketing effort, would approach this level, this strategy is best relegated to piecemeal efforts by interested commuters and employers. It may have some worthwhile social benefits, especially where inner-city people are able to gain access to suburban employers, but this type of program cannot be promoted for reasons of air quality improvement.

Shuttles to Activity Centers

This strategy would entail shuttle service, usually by van or minibus, between activity centers, such as apartment complexes, shopping malls, and employment centers, and transit stations. Service would in some cases be free, and may be available to anyone using the activity center (e.g., shoppers) or only to employees of a given activity center. In the latter case, there is some overlap with the subscription feeder service strategy, but here we assume a more frequent operation, and one not restricted to a given group of employees.

Shuttles of this kind can increase area mobility, especially to the elderly, handicapped, and non-car owners and although schedules are infrequent, they may be used on occasion by car owners. As the use of public funding for a service that supports commercial enterprises is unlikely, financial support would usually be provided by the activity center; coordination of a number of employers, stores, etc. may be required and demonstrations with adequate publicity are required to test the feasibility of shuttle routes on a case-by-case basis.

Issue Paper 2 has noted that the pollution reduction benefits of shuttles from area rail stations to other activity centers will be negligible. The only exception to this occurs in Trenton, where large numbers of New Jersey state employees drive state-owned cars for various work-related purposes, often between common points. Here, several shuttle bus routes have been proposed, to reduce the usage of state pool cars. (See Project NJ: 3-1).

This strategy, therefore, is limited to specific local areas, and cannot be considered a useful region-wide strategy.

Use of School Buses for Other Purposes

This strategy would entail the use of school buses for various local shuttle services in the suburbs during hours when they are not needed to transport school children or during summer recesses; it would allow new routes and special services to be demonstrated during summer and off-peak periods by using otherwise idle vehicles. Issue paper 2 estimates indicate that if 2 to 4% of home-based non-work trips could be diverted to this service, a 400 to 800 kg/day reduction in HC emissions would be possible.

The most serious obstacle to the use of school buses for public transportation is that they are not available during A.M. peak hours, and hence would not handle rush hour traffic. Hence, pollution reduction would not occur during the critical A.M. peak hour, and there would be relatively little impact on ozone formation.

Agency coordination in developing a program for other uses of school buses would be difficult as many school districts would be involved and it is uncertain whether an operating agency, contractor, or the school districts themselves would actually run the buses or who would drive them: there could be labor disputes if lower paid school bus drivers perform transit work, or if regular bus drivers operate school buses during off-peak hours. Driver availability, insurance problems, and extra wear-and-tear on the school buses are further obstacles.

Also, it is uncertain whether regulations on highway operation of school buses would apply; there may be confusion if drivers observe school buses stopping without flashing their lights in making passenger stops, leading to some non-observance if school bus passing laws during regular school runs. (School buses are painted yellow for maximum visability and identity with the function of carrying school children; diversion to other uses could weaken this identity.) If they were required to use their flashing lights at all stops, there would be adverse air quality impacts as other traffic would be unnecessarily delayed.

School buses are not designed for regular public transportation; they have a hard suspension and cramped seats, which reduce riding comfort, and a high step, which would be inconvenient for senior citizen users. They have only one door for entry and exit, which reduces efficiency of operation and do not come equipped with a farebox: substantial modifications would be needed to prevent robberies (a major reason for the present exact fare system on transit buses) or else special ticketing arrangements or free rides would have to be provided. It would require special ordering of school buses with proper suspension transmission, doors, farebox, etc. to allow satisfactory transit service.

In any case, even properly-equipped school buses would be available only during off-peak hours when the existing transit system has excess capacity; so it is rather doubtful whether they would really provide a significant supplement to transit buses in an expanded off-peak bus service, if it were desirable or economically feasible to provide such service.

A Radnor, Pennsylvania study indicated a number of legal problems in implementation, and the consultant study for Trenton recommended that school buses be used only on a contingency basis (Ref. 3, pp. 120-121).

Considering the various institutional, technical and scheduling problems, this strategy must be rejected as a serious solution to regional air pollution problems.

Taxis Operating as Jitneys

In this strategy, taxi cabs would operate as jitneys, carrying more than one party per cab, and running on a fixed route (with some route deviation allowed) for a set fare. This would probably be limited to low density areas, and would allow some marginal regular bus routes to be eliminated, while providing more frequent service.

Implementation of this strategy would require legal restrictions on shared-ride taxi operation to be lifted. This has been done in a few places (e.g., Washington, D.C.), where taxis continue to operate as an on-demand, non-scheduled mode.

Any jitney operation would need to be tightly regulated in terms of where and when it would be allowed to operate to avoid competition with well-patronized transit lines. Limited deregulation might be allowed in areas where no transit service exists now, allowing taxi drivers to run whenever they choose; however, it could result in poor service at some times of day, as taximen may prefer to operate in more congested areas where profits are more likely to be made.

Perhaps the most efficient use of jitneys as part of an integrated, coordinated transit system would be for operating authorities to charter taxis to run along marginal bus routes on a regular schedule during off-peak periods, providing a feeder service (with transfers) to regular transit. Night-time service allowing route deviation to drop off passengers at their doorstep (perhaps combined with dial-a-ride operation) would be especially welcome from a security viewpoint.

However, there could be objections to such a scheme by transit labor, which was successful during the settlement of the 1981 SEPTA strike in preventing the use of part-time labor, and would be unlikely to endorse the hiring of lower-paid taxi drivers to provide service on bus routes. Also, it is uncertain how many taxis would be available to provide service (whether under contract or not) in low density areas.

Considering the fact that jitneys would provide a marginal service far from the CBD, and that much of the service would be mainly during off-peak hours, it is believed that only minimal HC reduction could be realized during the critical AM peak period. Considering the difficulties in implementing this strategy and the small and uncertain benefits this strategy must be rejected as a viable air pollution control method.

Register-Ride Program

A register-ride program would entail registering drivers to pick up registered passengers along certain designated routes; passengers would help pay for the cost of the ride. Akin to "legalized hitch-hiking," this strategy would reduce the risk of picking up strangers, or accepting rides with strangers, that is inherent in ordinary hitch-hiking. It could provide transportation in corridors poorly served by or lacking in public transportation.

Issue Paper 2 suggests that a 1500 trip/day pilot program could divert 1000 daily trips previously made by auto and save 16 kg of HC emissions per day.

There could be legal problems in implementing a register-ride program, as hitch-hiking is illegal; and insurance questions would need to be resolved. Development of such a program might be hindered by resistance on the part of many drivers to picking up strangers, and many potential riders would be similarly hesitant to use it. Although it would certainly be much safer than ordinary hitch-hiking, there could still be some risk to participants.

There would be little incentive for drivers to pick up registered riders for free. If riders pay for these rides, there is a question of what constitutes fair compensation for the driver. A published mileage rate or gasoline charge (which could vary by type of car) could be used, but there exists the possibility of encouraging jitney-type operation by car owners, cutting into transit ridership and operating revenues.

Considering the numerous drawbacks of the register-ride concept, it is rejected as a realistic air pollution control strategy.

Uniform Bridge Tolls

In the Philadelphia area uniformity would require setting the same toll on bridges controlled by the Delaware River Port Authority (the Commodore Barry, Walt Whitman, Ben Franklin and Betsy Ross bridges) and the Burlington County Bridge Authority (the Tacony-Palmyra and Burlington Bristol bridges). This would allow one-way tolls to be established on all the bridges and, where tolls are raised, would permit preferential tolls to encourage high-occupancy vehicle use.

The very low toll on the Tacony-Palmyra Bridge, as compared to the DRPA bridges, prevents the full utilization of the higher priced Betsy Ross Bridge and may divert some traffic from the Ben Franklin and Walt Whitman bridges. It is very doubtful that equalization of bridge tolls, if it could be achieved, would involve a lowering of DRPA tolls to "compensate" for an increase in BCBA tolls, as this would have an undesired affect of encouraging more CBD-bound auto traffic on the southern bridges in competition with PATCO trains and with NJ Transit buses using the Ben Franklin Bridge.

Therefore, the only likely scenario would entail raising of BCBA tolls to the same level as the DRPA bridges. This would mean an overall increase of bridge tolls; it could result in a very small reduction in VMT, by discouraging a small number of non-work trips over the Tacony-Palmyra Bridge and reducing circuity of travel for a few trips between western New Jersey and the Philadelphia CBD. It would also ease congestion on this bridge during peak hours, by allowing a diversion of more traffic to the Betsy Ross Bridge, which has excess capacity, and might encourage more use of NJ Transit and Cherry Hill Transit buses between Frankford and New Jersey points (transit ridership along this corridor is, however, very small compared to the lines going across the Ben Franklin Bridge).

On the other hand, it could have a negative impact on local air quality in the Philadelphia center city area if more through (non-CBD bound) traffic is diverted from the Tacony-Palmyra to the Ben Franklin Bridge. In a sense, the present low toll on the Tacony-Palmyra Bridge lowers the impedence to movement of traffic around the CBD and may perform a useful function causing some traffic to bypass the downtown area.

The major impediments to implementing this strategy are political and institutional ones. For years efforts have been made (unsuccessfully) to resolve the issue of different tolls on these bridges. It is expected that existing Burlington County bridge users would strongly oppose an increase in the toll; and that a toll increase would be seen as lowering the attractiveness of the county for future development. Also, the authorities are legally prohibited from raising bridge tolls more than is necessary to pay for maintenance and the debt service on the bonds sold to finance bridge construction. Unless BCBA and DRPA merge (which is not expected), an equalization and increase of these tolls is unlikely.

In the case of the Trenton area, a consultant study investigated the possibility of uniform bridge tolls. Here, too, there exists a mix of toll and toll-free bridges. Again, local opposition makes it unlikely that uniform tolls will be established. This strategy was also rejected for the Trenton area (Ref. 3, p. 180).

Therefore, uniform bridge tolls have been rejected regionally as a strategy too difficult to implement. Even if it were possible to implement the reduction in emissions would be low, there could be adverse local impacts on the Philadelphia CBD.

One-Way Bridge Tolls

This strategy would involve modifying the toll collection procedure so that vehicles traveling in one direction would pay double the present toll with movement in the reverse direction being toll-free. This allows a reduction on idling at toll stations, with local CO reduction as one stop per trip would be eliminated and trip speed improved in the toll-free direction.

In the case of the Philadelphia area bridges, a moderate savings of about 27 kg/day in HC emissions is estimated in Issue Paper 2. As evening rush hour is more prolonged, collection would be made in an eastern direction so that the major westbound AM peak flow would not be impeded. This would have a beneficial effect in reducing ozone build-up during the day.

One-way bridge toll collection would be difficult to implement without a uniform bridge toll structure. If it were applied only to higher toll DRPA bridges, some motorists would drive into Philadelphia on the Walt Whitman, Ben Franklin and Betsy Ross bridges during the AM peak hour, and return on the Tacony-Palmyra Bridge, evading the high DRPA tolls. This would especially be the case in the northeast, where the Betsy Ross Bridge and Tacony-Palmyra bridges are close (even the latter bridge could lose some revenue during morning hours). The added circuity of travel as some drivers go out of their way to evade the high one-way toll would have a negative effect on air quality. Also, more through traffic could be diverted onto highways passing through the Philadelphia CBD area, to the detriment of local air quality.

In the Trenton area, one-way bridge tolls were investigated and rejected because of the close proximity of toll and free bridges (Ref. 3, p. 180). As uniform bridge tolls are unlikely for either Philadelphia or Trenton, oneway bridge tolls must be rejected as a regional air quality improvement strategy.

Walkways

Walkway improvements, including surface paths and grade-separated facilities to bypass heavily-trafficked streets, may be useful in providing access to transit terminals and in improving pedestrian movement between shopping centers and bus stops. Provision of walkways can improve the safety and comfort of pedestrian trips, provide more opportunities for exercise, and allow a small increase in transit ridership, if properly located.

Walkways usually do not have any negative impacts on air quality, unless additional pedestrian street crossings at grade are provided which cause cars to stop more frequently; conversely, pedestrian over/underpasses might allow a slight reduction in emissions by reducing pedestrian interference with traffic. Positive impacts resulting from improved pedestrian movement and pedestrian access to transit are difficult to quantify; presumably the walkways which have the greatest impact are those which are integral with transit station improvements. These are considered elsewhere, under station improvements (e.g., the Center City Commuter Connection concourse development), and will not be discussed again here.

Walkways unrelated to specific transit improvements are expected to have only a negligible and uncertain impact on air quality. Walkways per se are rejected as an effective air quality improvement strategy, although they may be desirable for a number of other reasons.

Auto-Restricted Zones

In this strategy, general traffic would be restricted from selected streets in congested areas either completely or at certain times of day. Where they continue to serve as public transit rights-of-way, with some widening of sidewalks and improved pedestrian amenities, they are termed transit malls. The kinds of air quality benefits which are obtained from auto-restricted zones are similar to those of auto-free zones but on a much smaller scale, with emission reductions only along individual streets.

Transit malls will reduce street capacity, but there is usually sufficient room on parallel streets to absorb the diverted traffic, and on-street parking spaces removed may be replaced by off-street parking. CBD-bound trips may be truncated slightly as shoppers park on peripheral lots, instead of on the street, but this may be balanced by an increase in circuity for through trips (origin and destination not in the zone).

The experience in Philadelphia (Chestnut Street Transitway), Minneapolis, and Portland, all of which have CBD transit malls, has been that automobile operating speeds have remained the same, with no noticeable decrease in traffic overall and only minor increases around the mall area, and more off-street parking. A notable increase in bus traffic occurred only in Portland (Ref. 18)

Philadelphia, unlike Portland, already had fast rapid transit, subway-surface, and commuter rail access into the CBD. In this situation, diversion to the slower bus service would not be expected: the benefits from the transit mall all would come from improved efficiency of operation of extant bus services and reduced travel time for bus riders.

Evidently, the transit malls studied thus far have had little impact on CBD air quality. Where bus traffic has increased, this may be due to induced transit ridership (new trips). Although it is possible that some auto shopping trips to suburban malls may be replaced by transit trips to the CBD, this is difficult to quantify.

The major objections to new transit malls come from downtown stores which fear a loss of retail sales when they are no longer on an automobile route with convenient on-street parking. Thus far, no U.S. city has more than one CBD transit mall; it would appear that the Chestnut Street Transitway has preempted the application of this strategy in the Philadelphia CBD. Considering the strong opposition by merchants to the initial establishment of this auto-restricted zone, and recent attempts to open up Chestnut Street to general traffic during evening hours, additional transit malls may be politically unfeasible. Although there are TSM projects to study the development of auto-restricted zones along Frankford Avenue in Philadelphia and in Media in Delaware County, it is unlikely that the volumes of transit traffic in these or in other parts of the region warrant removal of entire streets for exclusive bus or trolley use.

Parking control appears to be a more feasible solution for CBD traffic problems in Philadelphia; these are considered in the Center City Parking Study. Also, signal preemption has been planned to speed up three north-south bus and streetcar routes crossing the CBD (with the extant Chestnut Street lanes providing east-west flow through the same areas) (Ref. 27).

Outside of the CBD, transit lanes and signal preemption are planned for other congested corridors (Ref. 27). These transit lane improvements are expected to have a neutral or slightly positive overall impact on air quality (see discussion in reserved measures section), and to result in much less congestion than would closure of local streets to auto use. Hence, from an air quality viewpoint they are considered preferable to auto-restricted zones.

In view of the political difficulties in implementing this strategy, and considering the fact that better alternatives (parking restrictions, transit lanes and signal preemption) are planned, and that the air quality benefits are minor or nonexistent, further auto-restricted zones must be rejected as a regional air pollution control strategy.

Pedestrian Malls

Pedestrian malls involve the closure of streets to all but pedestrian traffic (though bicycles may also be permitted). Pedestrian malls may have streets converted to sidewalk areas, provided with benches and other amenities such as vegetation, banners, and other decorations to increase the attractiveness of the area. Pedestrian malls may be streets which are too narrow to allow both transit service and an enlarged sidewalk area; they may be combined with transit malls to form auto-free zones.

Pedestrian malls may enhance the CBD and regional centers as areas that are attractive to shoppers. However, businesses often object to closure of traffic, fearing the loss of sales and difficulties in obtaining deliveries of merchandise. Locally, pedestrian malls can reduce noise and air pollution; however, traffic tends to be diverted to parallel streets, as is the case with auto-restricted zones, so there may be very little if any overall change in air quality. Pedestrian malls are available for very small CBD areas, which minimizes their air quality impact. As buses are not permitted, transit service is less convenient than in transit malls.

It is probable that in Philadelphia proper, any extensive pedestrian malls would be combined with transit lanes to form transit malls. Future pedestrian-only shopping areas in the CBD are expected to be limited to off-street, enclosed shopping malls, like Gallery II. Such improvements, while desirable from a socio-economic standpoint in attracting people to shop downtown, are not promoted for air quality reasons.

There is at present a pedestrian mall in Trenton, the Trenton Commons. This is expected to be improved by private developers, by incorporating several new office buildings, to increase usage at the existing mall shopping area. However, air quality benefits of this development are likely to be negligible.

In general, pedestrian malls are difficult to implement, and provide very minor, if any, air quality benefits.

Auto Free Zones

Auto-free zones involve blocking off large CBD areas to all traffic except for surface transit and police and emergency vehicles. This allows shopping areas to be made pleasant, quiet, and safe for pedestrians, with a local reduction in air pollution from private vehicles. In Boston, a small auto-free zone, the Downtown Crossing was established in 1981, eliminating all traffic on two main shopping streets and creating a transit mall on the main through street. Auto traffic in the CBD was reduced by 5% and parking demand around the zone by 20%, with an increase in transit trips and pedestrian trips into the zone of 34% and 11%; respectively. A reduction of 148 tons of HC emissions per year has been estimated in this case. (Ref. 21).

For the Philadelphia CBD, the most likely regional site for an auto-free zone, Issue Paper 2 estimates that even without a change in mode, a 95 to 190 kg/day reduction in the HC emissions could be achieved by eliminating or truncating 25 to 50% of the auto trips entering the CBD. This assumes that people will park at fringe lots and walk or use loop buses to gain access to the zone. It might, of course, also induce some additional people to make their entire trip into the CBD by transit, by reducing the convenience of auto travel. However, as Philadelphia already has excellent CBD access by rapid transit, in addition to bus service on the existing major east-west transit mall, these gains would be smaller than would be the case in a bus-only city in which transit service is speeded up in the CBD simultaneously with the elimination of other traffic.

The major difficulty in establishing an auto-free zone in Philadelphia is that proposals for removing traffic from streets have been strongly opposed by business, as was the case when the Chestnut Street Transitway was planned; such opposition can be expected to be much greater in the case of an auto-free zone proposal. It is feared by downtown merchants that some potential CBD shoppers would not come to the CBD at all, especially in the case of trips for which autos are especially convenient (carrying heavy packages, trips by large families, etc.), and that center city shops would lose even more business to suburban malls than they have already.

Philadelphia already has some of the benefits of an auto-free zone in the Chestnut Street Transitway. It is believed that additional parking controls (under consideration in the Center City Parking Study) and signal preemption by transit vehicles on north-south routes through the CBD will achieve further improvements with many fewer political obstacles.

Although auto-free zone development would have some definite benefits from an air quality viewpoint, it would face serious implementation problems.

Fringe Parking

In this strategy, people who commute into the CBD by car, and some shoppers, would be encouraged to park on lots on the periphery of the CBD. This would truncate CBD-bound trips, with drivers walking or taking a shuttle bus to their destinations. The fringe parking would in some cases be free or much cheaper than core parking, as an inducement; or control over the number of spaces downtown would force drivers to park in the fringe.

Issue Paper 2 has indicated that a 6.1 kg/day HC emission reduction could be achieved by moving over 1000 parking spaces in Philadelphia and 500 in Trenton from the CBD to fringe lots an average of one mile from the core area. The benefits from this are very small compared to an estimated 188 kg/day HC emission reduction which would result from an expansion of park-and-ride lots. An independent estimate for the Trenton area indicates that fringe lots would allow only a 1.43 ton reduction in HC pollution/year, as compared to 20.5 tons allowed by park-and-ride facilities and 23.6 tons allowed by parking fees and other ride-sharing incentives. (Ref. 3, p. 228)

There are several problems in implementing this strategy and in realizing the theoretical reduction in air pollution. Businesses, including existing CBD off-street parking lot operators, would strongly oppose it. In Trenton, it is expected that commuter parking would be replaced by convenience parking spaces for shoppers (Ref. 3, pp. 143-144). This, while allowing more productive land use, might induce even more cars to drive into the CBD area, adding some mid-day HC emissions and partially cancelling out the reduction in commuter emissions. Also, unless the CBD were completely ringed by intercepting fringe lots, there would be added circuity of travel for many CBD commuters, cancelling out some of the benefits from reduced VMT in the congested core area.

In Trenton, fringe parking lots have been regarded as a temporary pollution abatement measure only, not as a really effective pollution control program (Ref. 3, p. 290). Considering the relatively small and uncertain benefits of this strategy, and the likely difficulties in implementing it, fringe lots must be rejected as an effective regionwide air pollution control measure.

Joint Park and Ride Fares

In this strategy park-and-ride passengers would buy a combined gate pass and monthly rail pass at a rate lower than the total presently paid for parking fees and train fare. This would be intended to encourage additional commuters to ride transit instead of driving into the CBD.

At present, parking is already free at many Pennsylvania suburban train stations. Where parking fees (usually low) are charged, pricing reflects a need to control congestion at heavily-used stations where space is limited; this encourages train riders to walk, bicycle or use transit feeder routes, and diverts much park-and ride traffic to alternative station locations at lower density suburban points. In New Jersey, free parking is available at Lindenwold line stations, with a low fee charged for parking closest to the station entrance. In Trenton, there is a parking charge at rail stations, but the lots are so full that parking overflows onto side streets (Ref. 3, p. 144).

Reduction of revenues from paid parking, therefore, would have an effect of reducing total revenues for operating agencies, which could promote service cuts and worse air quality as fewer people would use transit. Theoretically, discounted park/ride fares might be used to discourage use of station parking spaces by non-commuters, but there is no indication that this is a problem anywhere in the area.

This strategy is expected to generate very little if any new transit ridership; expansion of park-and-ride facilities will be far more effective from an air quality viewpoint.

Reduced Off-Peak Parking Fees

In this strategy, transit use would be encouraged during off-peak hours by reducing or eliminating parking fees. PATCO stations in New Jersey already provide free parking in sections of parking lots close to station entrances after 10 a.m.; the same could be done in Pennsylvania and in the Trenton area at existing pay parking lots.

Ideally, this strategy would shift unnecessary peak-hour transit trips to the off-peak period, reducing the need for additional equipment and train operators during rush hour. This could have some direct air quality impacts by shifting some driving to the station (and HC emissions) away from the AM peak period, which is most critical in ozone formation. However, relatively few non-work trips into the CBD are likely to be made during early morning hours whether there are parking fees or not, so it is doubtful that this strategy would impact the AM peak which is critical in ozone formation.

More importantly, free parking is already available at PATCO stations before 10 AM, and in the Pennsylvania suburbs, many free lots are available at all hours. Reduced fees, or free parking, could of course be implemented at pay lots in Pennsylvania, but the only impact on emissions would be a shortening of a few off-peak auto trips, as shoppers drive to a more convenient train station. The impact of this on air quality would be very small.

It should be noted that it is undesirable to raise parking fees in pay parking areas during peak hours to provide room for off-peak users at the same stations. This would result in fewer AM peak hour train riders, an increase in commuters driving into the CBD, and a worsening of air quality.

In Trenton, a recent consultant report has suggested that rail station parking fees might be reduced during weekends (as lots are already full during weekdays, no pricing strategy would be effective) (Ref. 3, p. 144). As the lots in question are privately-operated, it is uncertain whether reduced weekend fees will be easily implemented. In any case, although increased weekend train ridership would be desirable for a number of reasons (including increased revenues for the operating agency), it will probably have little impact on air quality.

Reduced off-peak parking fees would allow only a negligible reduction in emissions during off-peak periods.

Consolidation of Freight Terminals

In this strategy, transportation facilitation centers would be used for urban goods movement, consolidating smaller truck loads into larger lots for pick-up and delivery. This would reduce truck VMT and the congestion resulting from a multiplicity of truck movements within the urban area. Recently, the City of Philadelphia has attempted to relocate many truck terminals from the Bridesburg area to Eastwick.

This strategy is very difficult to implement, given the fragmented nature of the trucking industry (with many small truck lines and owner-operators), and the fact that consolidation may cause an economic burden to many operators which are already well-established in the area. Also, there are often proprietary reasons why truck deliveries are not consolidated (objections to goods being carried in the same trucks with a competitor's product, etc.). Recent trends in truck terminal development both here and abroad have been towards smaller terminals, due to congestion problems encountered in large trucking centers; there is apparently a need for much more study of the practicality of organizing large-scale consolidation terminals. Finally, work on the transportation facilitation center concept has suggested that there may be increased circuity of cargo movement, cancelling out many of the gains expected from consolidation of loads.

Considering the institutional difficulties and economic uncertainties associated with this strategy, and the fact that clear air quality benefits have not been demonstrated, this strategy must be rejected as an emissions control measure.

Increased Off-street Parking and Regulation of On-street Parking (Except for Philadelphia CBD)

There are a number of TSM projects relating to parking controls, other than those included by the Center City Parking Study. In Pennsylvania, these include increased off-street parking in Doylestown, in Bucks County; removal of on-street parking in Phoenixville, in Chester County; increased off-street and reduced on-street parking in Willow Grove, in Montgomery County; peak-hour parking prohibition along Route 13, in Delaware County; and increased off-street and regulated on-street parking in the Frankford Avenue area, in Philadelphia. Additional projects call for better enforcement of extant parking regulations, and for further local parking studies, including one in the City of Chester.

In New Jersey, there are projects for removal of peak hour parking on Route 168 and on Kings Highway, for parking prohibitions on U.S. 30 and on Route 561, and for added off-street parking in Camden County; for removal of on-street parking on Routes 537 and 541, and provision of off-street parking in Mount Holly, in Burlington County; and for restriction of parking on narrow streets in Trenton, in Mercer County. There are additional projects for enforcement of parking regulations and for a residential parking permit program in Trenton (Ref. 3, pp. 236-237).

The projects mentioned above are relatively small in scope and affect primarily suburban towns and local centers; they should have little if any impact on the modal split, unlike parking control measures in large CBD areas. A recent consultant study in Trenton found that parking restrictions on Perry Street and Broad Street would result in only a .2 and .4 kg/day HC reduction, respectively, while Warren Street restrictions would have no effect (Ref. 3, pp. 86-89); it is expected that overall, local parking controls will allow only a very small or negligible reduction in emissions. In addition, there is often considerable opposition by local businesses to the loss of convenience parking. Considering the limited scope of these projects, and the political difficulties in implementation, this strategy is placed on the rejected list.

Construction of Missing Highway Links

In this strategy, sections of proposed arterials and expressways which would allow substantial improvements in average travel speed would be constructed by 1987. This project would not include those highway links which have been assumed to be built by 1987 and which are listed in Chapter 1. This would reduce the number of stops for traffic along parallel existing routes. In the case of circumferential highways it could allow diversion of some through traffic around the CBD area. However, it would also result in the generation of new highway traffic, cancelling out some or all of the emissions savings. It could also result in an increase in low-density development and relocation of more employers to the suburbs, increasing the general dependence upon automobiles for transportation and weakening the position of the CBD.

Although there are safety benefits from the construction of these highway links, they may have negative impacts on the environment, including removal of public parks, wetlands and other wildlife areas, and prime agricultural land. This strategy is unlikely to result in any significant emissions savings; in some cases it could very easily cause a worsening of the air quality situation.

One-Way Streets

One-way, through streets can theoretically allow a small reduction in emissions, by reducing congestion which results when cars or trucks block traffic lanes on narrow, bi-directional streets. Paired one-way streets also allow more effective signal synchronization than do streets with two-way traffic. However, there is often a small increase in VMT, as more circuitous routing may be required, reducing slightly the savings in emissions. In the case of local streets with relatively little traffic, the main benefit from pairing streets for one-way movement will be realized in improved safety, rather than increased speed or capacity.

It is believed that previous "TOPICS" improvements have already optimized the number of one-way pairs in Philadelphia and in many suburban areas. In Pennsylvania, there are only two TSM projects for paired side streets (one each in Chester and in Montgomery county). In New Jersey, there are about a half a dozen one-way street projects, notably in Mount Holly in Burlington County and four projects in Camden County, including the U.S. 30 corridor. In Trenton, in Mercer County, it has been proposed to make Montgomery and Stockton one-way, reducing HC emissions by 1.4 kg/day (Ref. 3, pp. 86-87).

The major objection to one-way streets comes from businesses which are impacted by difficulty of access (Ref. 3, pp. 98, 105-106). Hence, political considerations often make it difficult to implement one-way street improvements in shopping and commercial districts. Considering the relatively small potential for further one-way street improvements, the small savings expected for individual projects, and the difficulty in implementation at the local level, this strategy is placed on the list of rejected strategies.

Restricted Truck Delivery

There are several TSM projects to restrict truck deliveries during peak hours. In Pennsylvania, these affect Arch and Race streets in the Philadelphia CBD, and Frankford Avenue from Church to Cheltenham. In New Jersey, there is an additional project to restrict truck deliveries on Route 537, in Burlington County. These actions would reduce congestion on major streets caused by trucks, which may block several traffic lanes while maneuvering into loading positions, and double-park while effecting their deliveries.

This measure is targeted at peak hours, reducing HC emissions during the AM peak, which contributes to the ozone build-up later in the day. However, considering the small area affected, it is expected that the air quality improvement will be practically negligible. Also, local opposition to restriction of truck deliveries, which may inconvenience some businesses and add to delivery costs (overtime may need to be paid to drivers and other personnel) is likely to make this strategy very difficult to implement.

Roadway Improvements

The TSM program includes over a dozen Pennsylvania projects for road widening, with the addition of lanes (often increasing arterials from two to four lanes), widening and paving shoulders, etc. There are also a few alignment and grade improvement projects. However, by far the most important category of area roadway improvement entails resurfacing (about 35 projects).

In New Jersey, there are about half a dozen TSM projects to add traffic lanes, involving widening and restriping of roadways. There are also a few projects to realign highways, widen bridges and underpasses, etc. But again, the largest number of roadway improvement projects (about 20) involve resurfacing roads and paving shoulders.

Roadway widening and lane addition projects may allow a small improvement in emissions by eliminating long vehicle queues during peak hour and other congested periods (however, induced traffic may subtract from these savings.) Alignment and grading projects may also allow a slight reduction in emissions by reducing circuity of travel, added gasoline consumption on upgrade portions, etc.

Under regular maintenance schedules, roadway resurfacing projects should have no impact on emissions. However, under conditions of deferred maintenance, an abnormally high percentage of broken-up pavement, with corrugations, potholes, and other surface irregularities, can lead to increased rolling resistance for rubber-tired vehicles, unnecessary stops and added vehicle miles as cars swerve to avoid bad spots in the roadway, etc., increasing emissions. It is possible that the net effect of resurfacing projects in this area will be to very slightly reduce vehicular emissions, although this would be difficult to quantify.

It is believed that very few of these projects would have more than a negligible impact on air quality.

Elimination of Four-Way Stops

In this strategy, four-way stops would be eliminated at intersections where two-way stop signs would appear to suffice (where a one-way street is involved, a three-way stop would be eliminated). This would allow a small reduction in emissions. Although four-way stops are very common in Philadelphia, there are at present no plans to eliminate them, as the public perceives that this intersection design is beneficial from the viewpoint of improved safety and as a means of controlling speeding through local neighborhoods. Considering the local opposition to removing four-way stops, which is substantial, and the very small air pollution impacts, this strategy is rejected as a useful air pollution control measure.

Left-Turn Restrictions

In this strategy, left turns would be prohibited or restricted during certain hours, preventing turning vehicles from blocking through lanes on narrow or congested streets. However, there are often VMT increases for the turning vehicles, which may have to make three right turns (or a combination of right and left turns), generally with additional stops, in order to execute the intended turning movement. This cancels out some of the emissions reduction which would otherwise be realized by reducing delay to through traffic; hence, the improvement in air quality is negligible in most cases. While there are some safety benefits from restricting left turns, implementation may be difficult due to objections by motorists who are inconvenienced.

Overall, left-turn restrictions are not a promising control measure; the few TSM projects of this nature will be mentioned under Intersection Improvements. There is no reason for considering this as a separate strategy of any importance.

Relaxed Restrictions on Right-Turn-on-Red

In this strategy, "no right turn on red" signs would be removed at locations where conditions do not appear to be unusually hazardous. This would allow a small reduction in travel delay, and could allow a very small (probably negligible) reduction in emissions. The main objections to removal are that it would result in an increase in accidents, and make pedestrian and bicycle crossings more difficult. As right turn on red were implemented as part of a nation-wide fuel conservation measure some years ago, it can be assumed that the resumption of a ban on these turning movements represents a legitimate local concern over traffic safety. Considering the opposition to the elimination of right turn restrictions and the very small emissions improvement allowed, this strategy is rejected as a useful air quality control measure.

Blinking Signals During Late Night Hours

In this strategy, traffic signals would change their normal daytime cycles with red, yellow, and green phases to continuously blinking, red and yellow lights during late evening hours, allowing fewer and shorter stops. This would allow a small (probably negligible) reduction in emission, affecting a very small number of vehicles. This emission reduction would not occur during the critical 6 to 9 AM period (or for that matter during daylight or early evening hours when most pedestrian activity occurs). It has been noted that blinking lights may pose a safety hazard to pedestrians in some neighborhoods.

Blinking lights have already been implemented on some area highways during late night hours, notably Chestnut and Walnut streets in Philadelphia (which are otherwise normally synchronized for free-flow traffic). Considering the very small benefits from a wider application of this strategy, it is rejected as a useful air pollution control measure.

Advance Traffic Information

In this strategy, more widespread use would be made of automated signs and radio communications to provide the motorist with information about traffic conditions on the roadway ahead. Theoretically, this could reduce emissions by directing motorists via less congested routes, where they will be subject to less start-and-stop driving and reduced idling. However, it could result in increased VMT if the alternative travel paths are longer; in some cases, the alternative routes may also have more red lights and stop signs, cancelling out of the benefits of reduced congestion.

Traffic information signs have already been tested on the Schuylkill Expressway, on the Roosevelt Boulevard Extension and on City Avenue. However, they have not been particularly successful. Although advanced traffic information has been recommended in a recent study for the Trenton area, as part of a broader traffic light synchronization program, the benefits are apparently negligible (Ref. 3, pp. 270-271).

It would require a very sophisticated electronic system for automatic vehicle monitoring, with computer simulation of traffic flows and immediate response in the form of speed advisory signals, etc., to make this strategy effective. At this point, the required technology is largely undeveloped, and is not expected to be available during the time period under consideration.

New and Improved Information Signs

A large number of TSM projects, both in Pennsylvania and New Jersey, deal with the replacement of old and missing signs with improved signs, and with placing new information and street signs. Some of these projects incorporate reflectors for safety purposes.

New and improved signing may allow a small, practically negligible reduction in vehicular emissions by reducing unnecessary route miles, routing drivers in the most direct way, etc. However, the air quality impact of improved signing is nearly impossible to quantify.

Exclusive Lanes For High Occupancy Vehicles (Except US 130)

In this strategy, lanes would be set aside on area highways with three or more lanes in each direction for exclusive use by carpools, vanpools, and buses, in order to discourage single-occupancy vehicles. For one-way streets, a single lane would be designated as a "diamond" or high occupancy vehicle (HOV) lane; for bi-directional arterials or freeways, a single lane would be so designated in each direction.

HOV lanes may be either with-flow or contra-flow, or entirely new and separate roadways. With-flow lanes require removal of existing traffic lanes; although they may allow a speed-up of bus and carpool traffic, they may result in more congestion in the remaining traffic lanes. It would require a substantial diversion to transit and HOV use in order to counteract the increase in emissions which may result from increased congestion of the other traffic. There may also be some negative impacts on truck traffic. With-flow lanes may be either next to the median or on the curb side; in the former case, it may be difficult for high occupancy vehicles to gain access to the lanes (restricting their use to long trips), while in the latter, there may be problems of interference with on-and off-ramps.

Contra-flow lanes operate against the flow of traffic, e.g., on the left side of a freeway median. They use otherwise underutilized space in the direction opposite the normal peak hour directional flow on radial highway facilities. There are, however, safety problems in implementing them, and difficulties in providing access. Generally speaking, they would be useful only for very long stretches of driving with few access points.

New HOV lanes are also possible, utilizing one or two lane roadways. This alternative requires a considerable capital expenditure and may result in excessive demand for land along existing highway corridors in urbanized areas. If space is available for a single new HOV lane, it may be made reversible (inbound AM and outbound PM); if space is available for two new HOV lanes, they may be designed for eventual conversion to a rail line.

Where streets are used for HOV lanes, there are often political problems in removing parking to make the lanes workable; and enforcement problems are multiplied with the increase in access points to the lanes.

In the DVRPC area, 23 highway routes leading into the Philadelphia CBD were initially analyzed for HOV feasibility (Ref. 6). As a result of this primary screening, ten routes comprising 15 highway sections were further studied. In Pennsylvania, the I-95, Vine Street, Schuylkill Expressway, and the US1 (Roosevelt Boulevard) corridors all proved to exhibit an HC emissions increase (18-29, 47, 111, and 239 kg/day, respectively), indicating that the removal of lanes for HOV traffic would cause a deterioration in speed for other users.

In the case of the Chestnut/Walnut Street corridor, a small HC savings (11 kg/day) was indicated; but in this instance, the configuration of the road, with only three traffic lanes and parking on both both sides, the tendency of drivers to keep to the middle lane to avoid colliding with double-parked cars and drivers maneuvering in and out of parking spots, and the requirement for Route D local buses to use the curb lanes for passenger stops suggest that it would be almost impossible to set up and enforce safe and workable HOV lanes. It seems that the traffic light synchronization of this corridor has already achieved optimum utilization of these paired one-way streets.

In New Jersey, the US 38/30 and US 42/I-676 corridors proved to show HC emission increase (5 and 282 kg/day, respectively). Only the US 130 corridor shows some promise for HOV lane development, and for this reason it is discussed separately under reserved measures.

As most of the HOV lane possibilities studied show a negative HC reduction (an HC increase) or are unsuitable from a design viewpoint, HOV lanes are unsuitable for Philadelphia area highways (except for US 130), and are rejected as a reasonable air quality control measure.

Flextime Promotional Effort

In this strategy, employers would change their work hours or arrange to have blocks of employees arriving at several alternative starting times and departing by several different closing times; or employees would be given the flexibility to arrive earlier or later than the regular starting time, and depart earlier or later than the ususal closing time. This would allow many employees to avoid traveling during the present rush hours and would have the affect of flattening out peak periods.

Issue Paper 2 has estimated that if 75,000 additional workers participated in the staggered work hours program, there would be a 14.8 kg/day reduction in HC emissions achieved through increasing average travel speeds by one mile per hour. The main effect is to reduce peak hour highway congestion, with less start-and-stop traffic and fewer traffic jams. The above calculation does not take into consideration, however, impacts on transit and other energy-efficiency modes.

Of particular concern is the impact on transit. Although it is true that peaking results in a more expensive public transportation operation, crowding of highways during peak periods encourages many workers to use transit to avoid driving under congested conditions. Staggered work hours may have the effect of increasing highway capacity and making it easier for many commuters to use their cars. Hence, there will be a shift from transit if flextime is expanded.

There may be a similar impact on ridesharing: there is less incentive to use carpools and vanpools if congestion is reduced by extending peak periods. Reduced utilization of high-capacity transportation modes will result in increased utilization of single-occupant private cars, thus cancelling any air pollution improvement allowed by the increase in average driving speeds. Alternative starting times may also complicate the arrangements for fellow employees to form carpools.

This strategy is probably effective in reducing emissions in small urban areas where there is little transit development; in this case, loss of a negligible number of transit riders would do little to offset the gains from increasing highway speeds. In urban large areas, like the Philadelphia region, there may be a substantial loss of transit ridership, cancelling the gains from reduced highway congestion. Considering the negligible air quality benefits of this strategy, and its probable negative economic and social impacts, staggered work hours must be rejected as a reasonable air quality control measure.

Episodic Controls

In this strategy, various techniques would be used to control emissions during periods of unusually heavy air pollution, e.g., during the summer months when ozone is a problem in this area. Episodic controls would include advisory signs and new announcements asking drivers to use transit or form carpools, and mandatory measures such as laws prohibit driving on freeways with only a single occupant per car. These control measures may be accompanied by public health announcements discouraging people from engaging in outdoor exercise.

Such controls are not very effective unless the smog alert period remains for three or four days. This may be the case in cities which are ringed by hills or mountains which favor the development of an inversion layer and prevent pollutants trapped underneath the layer from being blown away from the urbanized area. The Philadelphia area does not have a topographic setting, and seldom develops an inversion layer. It is also particularly difficult to predict the weather conditions which may lead to an ozone episode with any accuracy for eastern seaboard cities such as Philadelphia, which are characterized by rapid changes in weather (being influenced by both continental and oceanic air masses). Such episodes are generally very brief, and in the time it takes to recognize that an episode has begun and to put out advisory warnings, the episode is likely to abate.

It is also very difficult to set up carpools on short notice, or for transit operators to bring onto line additional equipment and call upon standby drivers and other personnel to handle increased loads on the system during smog alerts. Mandatory controls that restrict driving are likely to prove extremely unpopular with the public. Finally, some of the control measures are contradictory, i.e., if people are advised not to exercise outside, they may be discouraged from walking to work or to a bus stop, or from commuting by bicycle, measures which would be most useful in reducing levels of driving and lowering the output of HC emissions which contribute to the ozone buildup.

Considering the brief duration and unpredictability of ozone episodes in this area, and the difficulty of implementing effective control measures, episodic controls must be rejected as an air pollution control measure.

High-Density Development Adjacent to Transit

In this strategy, high-density development would be encouraged in the vicinity of mass transit lines and terminals, so that a high percentage of the population would live, shop, or work in areas with convenient access to public transportation. The policies of the Regional Development Guide and the Year 2000 Land Use and Open Space Plan would serve as a guide in applying this strategy. Some beneficial effects would be energy conservation (for heating as well as transportation) and preservation of non-renewable land resources, including prime agricultural land, parks, and wildlife areas.

At present, local municipalities commonly zoned for high densities in the vicinity of commuter rail stations and other transit facilities; however, development is primarily motivated by market forces. It is difficult to achieve consensus from the multiplicity of local governmental bodies to foster further high-density growth, and there is considerable resistance on the part of the public to control place of residence. At best, the regional planning commission can advocate high-density development, but there is no mechanism or institution for ensuring that the recommended policies will be translated into action.

It is doubtful whether major changes in land use will take place by 1987. The overall changes in land use and socio-economic factors influencing automobile ownership and VMT are already considered in the models used in forecasting 1987 emissions. Considering the institutional barriers to a major change in land use patterns within the time period considered here, a high-density development strategy cannot be considered a reasonable air quality control measure.

Review of Development Plans for Indirect Sources

In this strategy, a permit system would be established for new construction in which the developer must demonstrate that the project will not interfere with the attainment or maintenance of air quality standards.

The EPA attempted to implement a development plan review process in 1974, but has been discouraged by Congress from adopting such a program. At the local level, municipalities are reluctant to enforce review of development plans, because it is difficult to assess the costs and benefits, and because of the likelihood of adding to the cost of development, hence discouraging development in the area which has the review process. Locally, the Philadelphia Air Management Services has an indirect source review program, but does not issue permits.

This strategy appears to be politically unfeasible; therefore, it is rejected as an air quality control measure.

Reduced Student Driving

In this strategy, various means would be taken to reduce the level of student driving, including restriction of parking space at secondary schools, other parking restrictions, or shifting of some evening activities to late afternoon so that students would not need to drive home and return to school again in the same day.

Issue Paper 2 has suggested that if 1000 student auto drivers were to discontinue driving to school, there would be a 10 kg per day reduction in HC emissions.

This strategy would require cooperation from a multiplicity of school districts. Additional busing might be required, raising school costs. There might also be economic hardship to students who must reach part-time jobs after school. As there are a number of social, economic, and institutional problems that would need to be solved in order to implement this strategy, reduced student driving is placed on the list of rejected measures.

Equalization of States' Minimum Driving Age

In this strategy, the minimum driving age for Pennsylvania teenagers would be raised from 16 years to 17 years, the same as in New Jersey. A DVRPC estimate suggests that if Pennsylvania sixteen-year-olds in the Philadelphia area are no longer allowed to drive, 20,600 auto trips would be eliminated, resulting in a 153 kg/day HC reduction (assuming that alternative means of transportation are available to all teenage drivers.)

Actually, there could be some unfavorable economic impacts for school districts, as more school bus transportation would be required; and some of the savings could be counteracted by an increase in parents' chauffeuring of teenagers, resulting in two vehicle round trips per person round trip rather than one.

Implementation of this strategy would require action by the Pennsylvania State Legislature; application would presumably be statewide. It is doubtful however that the law would be changed on a statewide basis only to effect emission reductions in one section of the state, as there could be adverse economic impacts in the remainder of Pennsylvania particularly in rural areas.

Considering the uncertainty over the level of emissions reduction, and the institutional obstacles involved, this strategy is rejected as a reasonable air quality control measure.

Gasoline Rationing

In this strategy, the amount of fuel available per motor vehicle, per driver, or per household, would be limited, presumably with some form of coupon system to regulate purchases. Issue Paper 2 has indicated that if gasoline supplies were limited to 80-90% of normal demand, a 4500 to 9000 kg/day HC emissions reduction would be possible. (Ref. 19)

This strategy would not be practical to implement locally, due to the probability of evasion by buying gasoline outside of the DVRPC region. No state or federal gasoline rationing program is anticipated at this time. Also, it is almost impossible to establish an equitable means of distributing fuel; considerable economic hardship is likely for some automobile users, whatever means of allocation is developed. Black markets would probably emerge to supply gasoline to those who prefer to use more than their quota and can afford to pay a steep price, increasing the inequity of the system for different income groups. Finally, there would be great expense involved in setting up and administering such a program.

In the survey of attitudes towards potential air pollution control strategies, conducted in July 1980, considerable opposition to this strategy ws indicated. Of 82 citizen respondants, 49 were opposed to a rationing scheme, and only 19 in favor. It can be assumed that opposition on the part of the general public would be even greater.

Considering the many social, economic, and institutional problems associated with setting up a rationing scheme, this strategy must be rejected as a reasonable available air quality control measure.

Increased Fuel Taxes

In this strategy, an additional federal, state, or local (regional) fuel tax would be put into effect to discourage gasoline use for purposes of reducing vehicular emissions. Issue Paper 2 has estimated that with a 5 to 10% gasoline reduction, a 2300 to 4500 kg/day HC emissions reduction would be possible. Some of the revenues could be used to subsidize transit and other alternatives to the private automobile. (Ref. 19)

The implementation of such a tax for strictly air quality purposes seems unlikely at this time, as lawmakers have traditionally been reluctant to raise fuel taxes, which may cause some hardship to many low income people in lower-density areas who need to drive to get to their jobs. Nevertheless, state fuel taxes have occasionally been raised to generate revenues for much-needed roadway repair work, and the USDOT is currently investigating a 5¢ per gallon federal fuel tax increase (with 1¢ allocated to public transportation). It is possible that there may be additional state or federal fuel tax increases by 1987 which, although not intended for emission reduction purposes, would impact air quality in the DVRPC area.

However, it must be noted that fuel taxes have traditionally not kept pace with inflation, resulting in a "hidden" subsidy to private transportation in recent years. Raising fuel taxes at the federal or state level would help to prevent the cost of automobile use from dropping relative to the CPI, and in that sense should be regarded as a measure for maintenance of the existing highway system at a relatively constant level of comfort and safety.

It should also be noted that even if part of the proposed federal fuel tax increase is allocated to transit, it would only be a substitute for other federal revenues which will be cut back or which will not keep pace with the rising cost of providing transit service over the next several years. Hence, it cannot be considered that this part of the increased fuel tax really has air quality impacts.

It might be more appropriate to consider regional fuel taxes as an air pollution control strategy. However, this would require state constitutional amendments, and cooperation between the Pennsylvania, New Jersey, and Delaware state legislatures such that a uniform tax could be imposed throughout the DVRPC area and nearby Wilmington. An uneven regional fuel tax would result in evasion of fuel taxes by drivers crossing state line to purchase fuel in states which do not have as high a tax. The tax would also have to be in effect over a wide area beyond the urbanized region, again to prevent fuel tax evasion. There could be some unfavorable consequences of higher taxes within the DVRPC region, or a part of it, as many drivers might make circuitous trips to purchase fuel, increasing petroleum consumption and emissions in fringe areas.

As federal and state fuel tax increases appear to be only measures for constructing and maintaining the highway system, and local fuel taxes appear to face major institutional difficulties, this strategy must be rejected as a viable air quality control measure.

Increased Registration Fees

In this strategy, registration fees for private automobiles would be increased as a means of reducing vehicular emissions. Issue Paper 2 has estimated that if 2 to 5% of two-car families were reduced to ownership of a single car, and 5 to 10% of three-car families were reduced to two cars, there would be a 350- to 830 kg per day HC emissions reduction. (Ref. 19)

This strategy primarily discourages ownership of vehicles, and is only indirectly related to the number of vehicles miles traveled, which is of much more importance in determining the level of emissions generated. Hence, it is inequitable, taxing those who drive infrequently or only short distances as much as those who have a long commute or may make frequent or unnecessary trips. Also, it is not directed at auto use during peak periods, unlike gasoline taxes, which will generate more revenue per mile of auto travel during rush hour, due to the impact of congestion on automobile efficiency. The universal application of a high registation fee would impact all auto users, without regard to the availability of public transportation, whereas higher gasoline taxes would enable the car-owner but occasional driver to avoid the tax by using the train or bus.

In the survey of attitudes towards potential air pollution control strategies, conducted in July 1980, considerable opposition to this strategy was indicated: of 81 citizen respondents, 46 were opposed to increased registration fees, and only 19 were in favor of them. It can be assumed that opposition on the part of the general public would be even greater.

This strategy is decidely less effective and equitable than a gasoline tax, which is mileage-proportional. For this reason, it is rejected as an air quality control measure.

Increased Driver License Fees

In this strategy, driver license fees would be increased to a level sufficient to discourage driving for those who only occasionally require the use of a car. Although it is difficult to estimate the level of HC emission reduction that this strategy would allow, it is possible that it may be on the same order of magnitude as increased registration fees, e.g., perhaps as much as several hundred kg per day.

This strategy discourages people from becoming automobile drivers, and is not related to the number of vehicle miles driven or whether the trips are made during peak or off-peak periods, which are factors of much more importance in determining the level of emissions generated. It may discriminate needlessly against families in which several family members share the use of a single car. It can also have some negative social consequences in that it discourages people who do not regularly drive fom acquiring the necessary skills to drive a car in emergency situations.

In the survey of attitudes towards potential air pollution control strategies, conducted in July 1980, considerable opposition to this strategy was indicated; of 81 citizen respondents, 55 were opposed to increased driver license fees, and only 11 were in favor of them. It can be assumed that opposition on the part of the general public would be even greater.

This strategy is decidedly less effective and equitable than increased fuel taxes, and appears to be less equitable and socially desirable than increased registration fees. For these reasons, it is rejected as an air quality control measure.

Extension to the Norristown Commuter Rail Line

There is a TSM project to extend the Conrail commuter rail line in Norristown from Elm Street to U.S. Route 422 (Ref. 20). This would expand the service area of the line, and reduce the private vehicle miles traveled by some park-and-ride commuters.

The air quality benefits of this short route extension would be very small, considering the cost of the project ($7 million). As the future of the commuter rail system is at present very uncertain implementation may be difficult.

Other Preferred Treatment Measures for Buses and HOVs on Roosevelt Boulevard

A recent consultant study investigated various options for providing reserved lanes and other preferential treatment options for buses, carpools and vanpools on Roosevelt Boulevard. These included exclusive bus lanes in the local traffic lanes, carpool lanes in the express lanes, signal preemption by transit vehicles, and median loading/unloading platforms (Ref. 5).

A southbound AM peak hour bus lane would have a small air quality benefit, and is discussed under reserved measures. However, a northbound, PM peak hour bus lane was shown to increase travel time and fuel consumption for overall Roosevelt Boulevard traffic by 13 to 14%; and to result in an increase in air pollution (HC emissions would increase by .3 Kg/day, CO emissions by 51.5 Kg/day, and NOx emissions by .1 Kg/day). Although it is possible that the reduced bus travel time would divert some additional auto drivers to transit, resulting in a slight (probably negligible) reduction in HC emissions, it is doubtful that this would offset the considerable increase in CO emissions, and the overall air quality impact is expected to be negative.

The carpool lanes, in the express lanes in the center of the Boulevard, would extend from 9th Street to Pennypack Circle, and would be open to any vehicle with more than one occupant. A southbound AM carpool lane would increase HC emissions by 3.6 Kg/day and CO emissions by 517.8 Kg/day, while NOx emissions would decrease by 2 Kg/day; a northbound PM peak hour carpool lane would increase HC emissions by 2.5 Kg/day and CO emissions by 363.3 KG/day, while NOx emissions would be reduced by .5 Kg/day. Hence, the overall air quality impact would be negative. Travel time and fuel consumption would increase by 27 to 30% if these lanes were installed. Although an increase in the number of carpools might reduce the emissions levels cited above, the southbound, AM peak carpool lane was found to approach capacity around 9th Street, suggesting that only an increase in the occupancy level of existing carpools would be of benefit, i.e., 250 to 275 drivers would have to join existing carpools in order for the HOV lane to reach an air-quality "break-even" point with respect to existing pollution level. It it doubtful whether the HOV lanes would result in air quality improvement, and in view of the other adverse impacts, this strategy must be rejected.

Preferential signal treatment for buses, including bus-activated signals and rephasing of signals to match average bus operating speeds, were also considered. However, the present signal system is designed to optimize travel speed for general express and traffic; a preferential signal system for buses would disrupt the existing traffic flow, i.e., increase the number of stops per vehicle, and would probably result in an air quality disbenefit.

Finally, loading and unloading platforms for buses, located in the center medians, and serving as bypass lanes at congested intersections, were investigated; but only buses operating in the express lanes could use them (the present bus services use the local lanes). There woud be a substantial amount of weaving where buses must switch from curb-side stops in local lanes to median stops in the express lanes; and some delays upon re-entering traffic after picking up passengers at median stops. Therefore, this alternative appears to be impractical.

For the reasons cited above, the northbound PM peak hour bus lane, northbound and southbound HOV lanes, other measures such as preferential signals and median bus stops must all be rejected as useful air quality control measures.

APPENDIX C

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*11. Education Campaign to Reduce Hydrocarbon Emissions, DVRPC, January, 1982

12. The Philadelphia Center City Carbon Monoxide Study, Philadelphia Air Management Services, April 1982 (draft)

14. Memorandum by DVRPC staff on population projections to be used in transportation-air quality planning, July 1982

*15. Delaware Valley Highway Vehicle Emissions Inventory DVRPC, July, 1982

16. Benefit/Cost Analysis of the Center City Commuter Connection, study by Simpson and Curtin and Delaware Valley Regional Planning Commission, January 1972

17. A Summary Report on the Airport Rail Line Study - Patronage, Revenue and Costs, Report for Delaware Valley Regional Planning Commission by Simpson and Curtin, January 1972.

18. Streets for Pedestrians and Transit: An Evaluation of Three Transit Malls in the U.S., USDOT, Final Report, February 1979

*19. A Reconnaissance-Level Analysis of Potential Emissions-Reducing Strategies, Transportation-Air Quality Issue Paper 2, Delaware Valley Regional Planning Commission, July 2, 1980

20. Transportation System Management Element of the Transportation Plan for the Delaware Valley Region, Delaware Valley Regional Planning Commission, Draft, Chapter I through V and Appendix, October 1981

21. Auto-Restricted Zones, Study for Southwestern Pennsylvania Regional Planning Commission by Cambridge Systematics, Inc., 1981

22. Urban Transportation and Energy: The Potential Savings of Different Modes, Congressional Budget Office, U.S. Congress, 1977

23. Transportation Improvement Program, FY 1979-1984, Delaware Valley Regional Planning Commission, Section 7

24. Transportation Improvement Program, FY 1980-1985, Delaware Valley Regional Planning Commission, Section 7

25. Transportation Improvement Program, FY 1980-1985, Delaware Valley Regional Planning Commission, Section 7,

26. Capital Budget FY 1982 and Capital Program FY 1982-1987, Southeastern Pennsylvania Transportation Authority, 1981

27. Exclusive Transit Lanes Feasibility Study, City of Philadelphia report by Orth-Rodgers & Associates, Inc., February 1981

28. Transportation Element for Southeastern Pennsylvania of the 1979 State Implementation Plan, Delaware Valley Regional Planning Commission, April 1979

29. Proposed Revisions to the New Jersey State Implementation Plan (1979), and supplements, New Jersey Department of Environmental Protection, 1979

30. Annualizing Capital Cost Data, staff memorandum, Delaware Valley Regional Planning Commission, January 1982

*31. Transportation-Air Quality Planning Annual Report 1980, DVRPC, January 1982

*32. Transportation-Air Quality Planning Annual Report 1981 DVRPC, May 1982

*33. The Health Effects of Automobile Pollution, Delaware Valley Citizens Council for Clean Air, January 1982

*34. A Call for New and Innovative Measures to Reduce Pollutant Emissions from Motor Vehicles, Issue Paper #1, DVRPC, Revised February 28, 1980

*35. Collected AIR MAIL issues, DVRPC, available after February 1982

*36. Work Program for Public Participation, DVRPC, Revised January 7, 1980

37. Testing and Evaluation of the Recommended Year 2000 Transportation Plan, DVRPC, February 1981

38. The Transportation Decision Process in the Philadelphia Region, Louis E. Keefer Associates, Draft, February 18, 1981

39. Transportation Goals, Objectives and Standards in the Philadelphia Region, Louis E. Keefer Associates, Draft, October 1981

40. Analysis of the CO Hotspots for Burlington, Camden and Mercer Counties, Bernardin, Lochmueller and Associates, undated

*41. Delaware Valley Photochemical Oxidant Study, DVRPC, July 1982

*42. Public Hearing Testimony: Delaware Valley Transportation-Air Quality Plan, DVRPC, March 30, and April 15, 1982

*43. Transportation-Air Quality Hearings: Summaries of Testimony and Staff Responses, DVRPC, May 1982

*Supplementary transportation-air quality report, available upon request

APPENDIX D

Commitments

City of Philadelphia Department of Public Property
SEPTA
City of Philadelphia (Administration)
Greater Philadelphia Bicycle Coalition
New Jersey Department of Transportation
Delaware River Port Authority
City of Trenton Department of Housing and Development
Camden County Department of Planning
New Jersey Transit Corporation

CITY OF PHILADELPHIA

DEPARTMENT OF PUBLIC PROPERTY
1020 Municipal Services Building
Philadelphia, Pa. 19107

JOSEPH W. BROWN
Commissioner

JOHN F. McCLOSKEY, JR.
Deputy Commissioner

May 13, 1982

Mr. John J. Coscia
Executive Director
Delaware Valley Regional Planning Commission
1819 J. F. Kennedy Blvd.
Philadelphia, Pennsylvania 19103

RE: DELAWARE VALLEY TRANSPORTATION AIR QUALITY PLAN

Dear Mr. Coscia:

In your letter to me, dated April 6, 1982, you requested the City's commitment to a number of City transit projects that were recommended in the recently published "Delaware Valley Transportation Air Quality Plan." Since most of the projects enumerated in your letter are already in advanced stages of construction, and/or appear in the Fiscal Year 1982 City Capital Budget, we are committed to carry out each project contingent upon the receipt of any necessary Federal and State transit capital funds.

The implementation status of the projects listed in your letter appears below:

Project PA: 3-1 NEW RAPID TRANSIT VEHICLES

The 125 new car order for the Broad Street Subway will be delivered in 1982 and 1983.

Project PA: 3-4 RAPID TRANSIT STATION IMPROVEMENTS

Design for the Broad Street Subway Columbia Avenue Station improvement project is underway. And the 8th Street Concourse improvement design will begin shortly. Construction completion for both projects is scheduled for 1984.

Project PA: 3-6 TRANSIT SAFETY AND SECURITY

The City-sponsored City-wide rapid transit station closed circuit television surveillance project has been expanded to include 30th Street Station, Suburban Station and Concourse, and the new Market Street East Commuter Rail Station. The target date for project completion is in October 1983.

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MAY 18 1982
DELAWARE VALLEY
REGIONAL PLANNING
COMMISSION

Project PA: 3-9 ROUTE 66 TRACKLESS TROLLEY EXTENSION

The planning effort is complete. The engineering phase is scheduled for FY 1983 and construction in FY 1984 contingent upon high regional Annual Element priority and UMTA funding.

Project PA: 6-1 AIRPORT HIGH SPEED LINE

Construction is underway with completion by mid-1983 and full operation by January 1984.

Project PA: 6-2 CENTER CITY COMMUTER CONNECTION

Construction is scheduled for completion in early 1984.

Project PA: 11-2 OTHER BICYCLE MEASURES

The City-FHWA Transit Station Bicycle Locker program will continue through at least 1983 with the relocation of some lockers at under-utilized sites to other stations with a higher potential market.

Project No. (Unspecified) CIVIC CENTER AND EASTWICK RAIL STATIONS

Both projects appear in the FY 1982 and FY 1983 City Capital Budgets. Engineering is scheduled for FY 1983 and construction in FY 1984 contingent upon high regional Annual Element priority and UMTA funding.

The City has worked closely with DVRPC and SEPTA in the regional prioritization of UMTA-funded capital transit projects, and we hope continued cooperation and sufficient funding will enable us to completely implement these important transit and air quality improvement projects.

Sincerely yours,

J. W. Brown

J. W. Brown
Commissioner

JWB/DF/mk

cc: D. Fogel
G. Shaeffer
D. Williamson
C. Zearfoss

Southeastern Pennsylvania
Transportation Authority

Executive Office
130 South 9th Street
Philadelphia, Pa 19107
(215) 574-7300

June 2, 1982

RECEIVED
JUN 3 1982
DELAWARE VALLEY
REGIONAL PLANNING
COMMISSION

Mr. John Coscia, P.E.
Executive Director
Delaware Valley Regional
Planning Commission
1819 J.F.K. Boulevard
Philadelphia, PA 19103

Dear Mr. Coscia:

During the last year, members of my staff have been cooperating with the Delaware Valley Regional Planning Commission in the development of the "Delaware Valley Transportation Air Quality Plan." The purpose of this plan is to advance certain capital and operating projects which will help the region attain the national air quality standards as legislated in the Clean Air Act Amendments of 1977, and to provide input to the 1987 State Implementation Plan (SIP).

Since your letter to me of March 5, 1982, requesting commitments to various projects which will have an impact on regional air quality, our respective staffs have met several times to discuss the projects referenced in your letter and the type of commitment that SEPTA is able to make at this time. Those commitments fall into five general categories:

1. Previously funded projects which SEPTA is committed to complete.
2. High priority projects which SEPTA is committed to complete subject to the availability of funds and annual review of capital project priorities.
3. Projects which are programmed in the FY'82 - '87 Transportation Improvement Program for which firm schedules have not yet been developed. Many of these projects will not be completed within the time frame addressed by the 1987 SIP, and SEPTA

is not in a position to make any firm commitments to these projects at this time.

4. Projects which are not currently programmed, but have been suggested for review and evaluation during the Transportation-Air Quality planning process. SEPTA cannot make any commitments to these projects at this time.
5. City of Philadelphia projects - the City would be in a better position to provide information on these projects.

We recognize that DVRPC is seeking firm commitments to projects which will assist the region in meeting the requirements of the Clean Air Act; however, due to the uncertainties surrounding future federal, state and local funding, SEPTA is unable to make a firm commitment to projects which are not already fully funded.

The attached table shows the SEPTA projects referenced in your letter of March 5th in the appropriate commitment category as described above, and indicates an anticipated completion date for funded projects. In cases where the DVRPC staff has combined several projects, we have separated the elements which fall into different commitment categories.

If you have any questions on this material or require additional information, please contact John Petro, Senior Environmental Analyst, at 574-7908 or Carol H. Lavoritano, Manager, Program Planning & Development at 574-7379.

Sincerely,

David L. Gunn
Chief Operations Officer/
General Manager

DLG/jm

Attach.

DELAWARE VALLEY TRANSPORTATION AIR-QUALITY PLAN

SOUTHEASTERN PENNSYLVANIA TRANSPORTATION AUTHORITY PROJECTS

SUMMARY OF COMMITMENTS

Commitment Categories:

1. Previously funded projects which SEPTA is committed to complete.

2. High priority projects which SEPTA is committed to complete subject to the availability of funds and annual review of capital priority projects.

3. Projects which are programmed in the FY'82 - '87 Transportation Improvement Program for which firm schedules have not yet been developed. Many of these projects will not be completed within the time frame addressed by the 1987 SIP, and SEPTA is not in a position to make any firm commitments to these projects at this time.

4. Projects which are not currently programmed, but have been suggested for review and evaluation during the Transportation Air-Quality planning process. SEPTA cannot make any commitments to these projects at this time.

5. City of Philadelphia projects - the City would be in a better position to provide information on these projects.

Project		Commitment Category	Anticipated Service Date (if project is funded)
PA: 3-1	New Rapid Transit Vehicles	5	
PA: 3-2	New Light Rail Vehicles		
	• 141 Light Rail Vehicles	1	August, 1982
	• New Norristown High Speed Line Cars	3	
	• New Surface Vehicles	3	

Project		Commitment Category	Anticipated Service Date (if project is funded)
PA: 3-3	New Buses		
	• 150 Advance Design Buses (FY'80 & '81)	1	September, 1982
	• Statewide Bus Pool (450 buses - FY'81, '82, '83)	1	150 buses in '83, '84 and '85
	• 150 Buses Per Year	2	150/year
PA: 3-4	Rapid Transit and Light Rail Station Improvements		
	• Broad Street Subway Stations (12 Stations)	1	December, 1983
	• Subway Surface & Market Street Stations		
	Engineering & Phase I Construction	1	1985
	Phase II Construction	2	1985
	• 69th Street Terminal Renovation	3	
	• Norristown High Speed Line Stations	2	
	• Columbia Station	5	
	• 8th Street Concourse	5	
PA: 3-5	Regionwide Shelters & Signs	3	
PA: 3-6	Transit Safety & Security		
	• Fire Prevention and Passenger Safety		
	Phase I	1	June, 1984
	Phase II	3	
	• Closed Circuit TV	5	
PA: 3-7	Seasonal Fare Reduction	4	
PA: 3-8	Park & Ride Bus Service	4	
PA: 3-9	Route 66 Extension	5	
PA: 3-10	Newtown Electrification	3	
PA: 6-1	Airport High Speed Line	5	
PA: 6-2	Center City Commuter Connection	5	

RECEIVED
MAY 12 1982
DELA... REGIONAL PLANNING COMMISSION

C I T Y   O F   P H I L A D E L P H I A

WILLIAM J GREEN
MAYOR

May 10, 1982

Mr. John Coscia
Executive Director
Delaware Valley Regional Planning
Commission
1819 John F. Kennedy Bouldevard
Philadelphia, Pennsylvania 19103

Dear Mr. Coscia:

I understand that DVRPC is in the process of completing its regional Air Quality Plan, which includes a discussion of parking strategies that could be used to reduce vehicle emissions.

Please be advised that the City Administration this year is proposing to embark on a comprehensive parking management program. The Mayor is proposing the following specific steps:

1. Parking meter fees in the CBD will be increased from the present rate of 25¢ per hour to 75¢ per hour.

2. 2500 new meters will be installed in Center City and the institutional sections of University City.

3. $3,000,000 has been budgeted for the year beginning on July 1 for improved on-street parking enforcement. This will entail an increase in the number of tickets issued, a more effective towing program, use of the "Denver Boot" for scofflaws, and improved computerized processing of tickets issued. The enforcement effort is expected to substantially reduce the extent of illegal parking in Center City, which will result in improved traffic flows and better surface transit operations.

The Commission may utilize this letter as an indication of the City of Philadelphia's commitment to this important component of the region's air quality program.

Sincerely,

David Williamson

DAVID WILLIAMSON
Transportation Coordinator
City of Philadelphia

m

BIKE FOR A BETTER CITY

15 June 1982

Delaware Valley Regional Planning Commission
1819 J.F. Kennedy Blvd.
Philadelphia, PA 19103

Dear Commissioners:

The Greater Philadelphia Bicycle Coalition will publish 10,000 copies of the new Bicycle Map of Philadelphia and Vicinity, prepared under contract with you.

Enough funds will be generated from the sale of the first edition of the map to assure its timely updating.

Very truly yours,

Robert P. Thomas

Robert P. Thomas
Project Manager

RPT:ae

REGIONAL PLANNING DIVISION
JUN 16 1982
DVRPC

·GREATER·PHILADELPHIA·BICYCLE·COALITION·
·P·O·BOX·8194· PHILADELPHIA ·PENNA· 19101 ·
·TELEPHONES· (215) 561·0928/387·9242

IN REPLY PLEASE REFER TO

State of New Jersey
DEPARTMENT OF TRANSPORTATION
1035 PARKWAY AVENUE
P.O. BOX 101
TRENTON, NEW JERSEY 08625

Anne P. Canby
COMMISSIONER

April 13, 1982

Mr. Kent Miller
Director, Regional Planning
Delaware Valley Regional Planning Commission
1819 J.F.K. Boulevard
Philadelphia, PA 19103

Dear Mr. Miller:

The New Jersey Department of Transportation (NJDOT) and the New Jersey Transit Corporation (NJ TRANSIT) have reviewed the draft State Implementation Plan (SIP) prepared by the Delaware Valley Regional Planning Commission, and have a number of concerns about the commitments proposed for both agencies to achieve compliance with the air quality standards. Our concerns are two-fold:

1. The overall magnitude of investment proposed is substantially more than we can realistically contemplate, given our resource limitations and our resolve to spend these limited resources as prudently as possible.

2. We believe a number of the proposals are not cost-effective strategies for reducing pollutant emissions.

While the improvement of air quality continues to be a primary objective of NJDOT and NJ TRANSIT, it is one objective among many, and prospective projects and strategies which promise pollution relief must be subject to the same comprehensive evaluation as projects contemplated for other purposes. While air quality should be an important factor in the evaluation, it should not, in my judgment, override all other considerations. Thus, rather than making a host of project commitments, we are prepared to reaffirm our commitment to those projects and strategies which are already programmed for implementation, and to comprehensively evaluate the remaining prospective projects and strategies which we regard as potentially cost-effective, with air quality being accorded an added weight in the evaluation.

Consistent with this thinking, attached you will find our detailed comments which will enable you to differentiate between (1) the projects we are prepared to commit to, (2) the remaining projects and strategies that we believe should be retained for evaluation, and (3) those which we believe should be dropped on cost-effectiveness grounds.

These comments and review have been prepared after joint consultation and endorsement of the New Jersey Departments of Environmental Protection and Transportation and the New Jersey Transit Corporation.

Should you have any questions regarding these comments, please contact John C. Jones of my staff at 609-452-9525, extension 302.

Sincerely,

Alfred H. Harf

Alfred H. Harf
Acting Director
Transportation Planning and Research

attachments

NJDOT

DETAILED COMMENTS ON TEXT OF DVRPC

DRAFT STATE IMPLEMENTATION PLAN

Regional Strategies

I. NJDOT

a. The New Jersey Department of Transportation is committed to the use of the Department's recently developed "Bicycle Planning and Design Guidelines." These guidelines will become an integral part of the Department's design criteria for new projects and for modifications to existing roadways. Additionally, the provisions called for by these guidelines will be adopted where economically feasible and where such shared use of the roadway will not present a safety problem for motorists or bicyclists.

b. Add to Appendicies of DVRPC Plan: NJDOT Bicycle Planning and Design Guidelines.

c. Page 2-78, project NJ4-4, Statewide Ridesharing Program: The New Jersey Department of Transportation, Office of Ridesharing is committed to a program of employer ridesharing promotion. However, NJDOT requests that DVRPC revise the narrative in the Plan to be consistent with the description and quantifiable data supplied by our Office of Ridesharing (see attachment 1, letter dated 3/5/82, Obermeier to Haikalis).

d. Pages 2-54 to 2-55: Shuttle Service between State Offices

Pages 2-56 to 2-57: Park-and-Ride Express Bus Service for Trenton

Pages 2-70 to 2-72: Park-and-Ride Bus Service

NJDOT supports these services conceptually, but is not prepared to make such commitments until Phase III of the "Trenton Area Study" is complete, at which time we expect to be able to evaluate the merits of specific proposals and proceed with those judged to be cost-effective.

e. Page 2-59: New Buses, responsibilities: Remove reference to "NJDOT" and add "NJ TRANSIT".

f. Pages 2-72 to 2-73: Use of State Pool Vehicles for Carpools

Pages 2-74 to 2-75: State Leasing of Vans for Employee Ride-Sharing

Pages 2-76 to 2-77: Parking Measures to Encourage Ridesharing by State Workers

NJDOT supports these proposals conceptually, but is not prepared to make any commitments until Phase III of the "Trenton Area Study" is complete. This study will provide a factual basis for assessing the desirability of these proposals. It is conceivable that State government lacks statutory authority to proceed with one or more of these proposals, in which case new legislation would have to be sought.

g. Pages 2-80 to 2-81: I-295 Interchange at Woodcrest PATCO Station.

This project is scheduled for completion in the fall of 1982. Additionally, delete "(2) for parking lot expansion, borne by DRPA."; note (1) is correct for both construction of ramps and parking lot expansion. Also, NJDOT is responsible for both the interstate portion of this project and the parking lot improvements. DRPA will be responsible for the operation of this parking lot. NJDOT is committed to the completion of this project.

h. Pages 2-88 to 2-89: Educational Campaign to Reduce Automobile Emissions.

NJDOT supports the concept of a campaign to raise the awareness of efficient automobile driving techniques. However, since this project is contingent upon the approval of funds by two states and the private sector, and the definition, development and coordination of this bi-state effort, NJDOT requests that this project be removed from the recommended category and be included in the reserved category until the above concerns are further defined.

II. NJ TRANSIT (See attachment 2, letter dated 3/3/82, Zupan to Harf)

Projects on the State Highway System

a. Page 2-86, Intersection Improvements at CO Hot-Spots

The "draft" DVRPC Plan indicates that 22 intersections in New Jersey were identified at exceeding standards for CO after 1982. However, only 21 intersections are shown and not all of these intersections exceed the standard of 9.0 ppm.

b. Page 2-90, Intersection Improvements at CO Hot-Spots

NJDOT is not responsible for all intersections listed. Only 5 of the 21 intersections occur on State jurisdictional highways; and only 4 of the 5 exceed the standard of 9.0 ppm.

State Responsibility	1982 CO Concentrations
Market and So. Warren, Trenton	11.36 ppm
W.State and N.Warren, Trenton	10.53 ppm
W.Hanover and N.Warren, Trenton	9.86 ppm
W.Front and N.Warren, Trenton	9.78 ppm
Market and So. Broad, Trenton	6.35 ppm*

NJDOT does not have any projects programmed for implementation at these four hot-spots. The Department will examine these identified hot-spots however, to define prospective solutions and to evaluate the desirability of the resultant project proposals in the context of overall needs and funding limitations. When evaluated, these projects will be accorded

*below the standard of 9.0 ppm

added weight (i.e., a project which is evaluated to be a given priority level using the normal evaluation procedure, would be moved up one level if it addressed a hot-spot problem).

Local Projects

Commitments on specific local projects will have to await the establishment of priorities by member governments in light of financial constraints and overall transportation needs. We have asked member governments to do so, and have urged prompt responses to permit completion of this effort (see attachment 3, letters dated 3/26/82 to Feldman and Matheisus). If the member government responses are received subsequent to your preparation of a final report, the Departments of Environmental Protection and Transportation will address this issue as part of the "overall" State Implementation Plan.

##

attachments

DELAWARE RIVER PORT AUTHORITY
OF
PENNSYLVANIA AND NEW JERSEY
BRIDGE PLAZA
CAMDEN, NEW JERSEY 08101

(609) 963-64
(215) 925-87

JAMES R. KELLY
PRESIDENT

April 21, 1982

Mr. John Coscia, P.E.
Executive Director
Delaware Valley Regional Planning Commission
1819 J. F. Kennedy Boulevard
Philadelphia, Pennsylvania 19103

Dear Mr. Coscia:

This letter is in response to your request for an implementation schedule for our proposed project designated by your agency as:

- Project No. NJ: 8-2 PATCO Lindenwold Station Parking Expansion -

We understand that this project will be part of the Delaware Valley Transportation Air Quality Plan to help this region attain federal standards by 1987, as required by the Clean Air Act of 1977.

The following information concerning the status of this project may be helpful:

a - This project has been included in the capital program approved by our Board of Commissioners on December 16, 1981. This programming includes local share funding for an UMTA project.

b - The project is included in the approved DVRPC Annual Element FY-1982 of the Transportation Improvement Program for Public Transportation.

c - Funding for this project has been requested from UMTA. A Grant Amendment was filed on September 8, 1981 and is currently being processed. Engineering and land acquisition are contingent upon UMTA project approval and funding.

d - Pending approval of federal funding, anticipated project construction could begin by the Spring of 1983 and be completed by the Fall of that year.

If this project does not materialize, Mr. Willard Cooper of DRPA staff will continue to cooperate with the DVRPC in regional efforts to obtain Plan objectives.

Very truly yours,

JAMES R. KELLY
President

WC/n

City of Trenton Department of Housing and Development

May 17, 1982

Mr. Ron Roggenburk
Delaware Valley Regional Planning Commission
1819 J. F. Kennedy Boulevard
Philadelphia, P.A. 19103

re: Transportation - Air Quality Plan

Dear Mr. Roggenburk:

The draft resolution of the Transportation - Air Quality Plan dated April 28, 1982 deletes several C.O. hot spots in Trenton since it uses different emission factors approved by E.P.A. There are now five remaining hot spots in Trenton, intersections where the CO concentrates exceed standards in p.p.m. for 1982. None are now in violation for 1987. The State of New Jersey has affirmed its responsibility for two of these; Market Street - South Warren Street and West State Street - North Warren Street, in its April 13, 1982 letter from NJDOT to DVRPC stating that they will examine them to define prospective solutions and the resultant project proposals would be accorded added weight on a priority level.

The City wants to address its commitment to the remaining three intersections as follows:

1. Perry Street - Montgomery Street, and 2. Perry Street - Stockton Street. Reconstruction is underway for realigning Perry Street from North Warren Street to North Broad Street. This will increase the traffic flow as there will be an additional lane for left turning. (The realigned section is one block from Montgomery Street and two blocks from Stockton Street) Upon completion of construction - this fall we will ask the police division for stricter enforcement of parking prohibitions during the peak hours.

3. W. State Street - N. Willow Street. The traffic signal has been retimed manually to reflect present traffic volumes. Restriping the west approach will be studied. Plans are also underway to extend Hanover St. westward from Warren St. to increase traffic flow. This project would be adjacent to a new State office building.

Sincerely yours,

Thomas Ogren, Director
Housing and Development

OFFICE OF THE
PLANNING BOARD AND
DEPARTMENT OF PLANNING

Planning Director
Joseph T. Paterno, PP, AICP

Camden County

County Administration Building
600 Market Street, Camden, New Jersey 08102
(609) 757-8620

April 2[illegible]

REGIONAL PLANNING
DIVISION

APR 28 1982

DVRPC

Mr. Alfred H. Harf
Acting Dir. of Transp. Planning
NJDOT and Research
1035 Parkway Avenue
P.O. Box 101
Trenton, N.J. 08625

Dear Mr. Harf:

In regard to your letter of March 26, 1982 to Mr. Feldman concerning Transportation - Air Quality Planning, please let me update you on Camden County's commitment to the State Implementation Plan. Several of the intersections are programmed on the FY83-87 Draft Transportation Program which appear in the Delaware Valley Transportation - Air Quality Plan. These projects are listed on the attached page.

In addition to the intersection improvements, Camden County has programmed funds for a Van Pool Loan, project. Moreover we are planning a County Employee Ride Sharing program, and 3 park and ride locations have been identified. These are the efforts our county is taking to help improve air quality in our region.

Please refer any questions to Mr. Harold Hill of my staff at 757-8680.

Very truly yours,

Joseph T. Paterno

JOSEPH T. PATERNO, PP, AICP
Planning Director

JTP/hjh/sw
cc: Joseph J. Roberts, Jr., Freeholder-Director
Wayne R. Bryant, Esquire, Freeholder
Eugene Feldman, Freeholder
Barton E. Harrison, Chairman, CCPB
Nick Rudi, County Administrator

AIR QUALITY INTERSECTION ON TIP

TIP Ref. No.			
2171	72 Intersections Countywide	include:	Haddon & Collings Ave. Haddon Ave & Browning Rd. Broadway and Mercer St.
2157	City of Camden 12 Intersection Group II M000S-095		Federal and Broadway
2018	12 Intersections Countywide M000S-027 (310-311)		Kings Hwy & Haddon Kings Highway, Potter Grove

1) Broadway and Market Streets in Camden City had work completed prior to AQ-Plan. Engineering by Ruetter Associates, Camden, N.J.

2) Haddon Ave. & Cuthbert Blvd. in Collingswood Borough has been completed prior to AQ-Plan.
Engineering by Parsons Brinkerhoff.

(New Jersey Transit Corporation letter of commitment was not received in time for publication. Please staple here when it is transmitted.)

EMISSION INVENTORY FOR SOUTHEASTERN PENNSYLVANIA

TABLE

SUMMARY TABLE OF REACTIVE VOC EMISSIONS*
FOR THE FIVE COUNTY SOUTHEASTERN PENNSYLVANIA REGION

	Base Year 1980		Baseline Projection 1987	
	Point	Area	Point	Area
STORAGE, TRANSPORTATION AND MARKETING OF VOC				
Oil and Gas Production & Processing				
Gasoline and Crude Oil Storage[1]	13,159		8,863	
Synthetic Organic Chemical Storage & Transfer				
Ship and Barge Transfer of VOC	5,822		5,822	
Barge and Tanker Ballasting	6,247		6,247	
Bulk Gasoline Terminals	210		210	
Gasoline Bulk Plants[3]	577		577	
Service Station Loading (Stage I)		10,218		305
Service Station Unloading (Stage II)		12,694		9,134
INDUSTRIAL PROCESSES				
Petroleum Refineries	45,864		29,469	
Organic Chemical Manufacture	4,709		2,582	
Inorganic Chemical Manufacture	5,004		5,004	
Pharmaceutical Manufacture	248		248	
Plastic Products Manufacture	51		51	
Rubber Tire Manufacture	2,721		952	
Textile Polymers & Resin Manufacture				
Synthetic Fiber Manufacture				
Iron and Steel Manufacture	5,537		2,248	
Others	7,258		6,009	
INDUSTRIAL SURFACE COATING				
Large Appliances	937		256	
Magnet Wire				
Automobiles	249		90	
Cans	6,682		1,834	
Metal Coils	1,619		1,415	
Paper	41,487		18,803	
Fabric	768		325	
Miscellaneous Metal Products	2,508		2,023	
Plastic Parts Painting	2,049		2,049	
Large Ships	387		194	
Large Aircraft	45		45	
Others	1,396		1,396	

*Kilograms per day (kg/day) for a typical summer weekday

	Base Year 1980 Point	Base Year 1980 Area	Baseline Projection 1987 Point	Baseline Projection 1987 Area
NON-INDUSTRIAL SURFACE COATING				
Architectural Coatings		20,969		20,918
Auto Refinishing	125	12,172	125	12,537
Others	218		218	
OTHER SOLVENT USE				
Degreasing	1,482	13,676	1,087	10,232
Dry Cleaning	145	6,849	145	6,863
Graphic Arts	18,435	3,646	11,466	3,637
Cutback Asphalt		2,802		2,656
Consumer/Commercial Solvent Use		28,722		28,649
Adhesives	26		26	
Other	483		483	
OTHER MISCELLANEOUS SOURCES				
Fuel Combustion	2,857		2,853	
Solid Waste Disposal	776		776	
Forest, Agricultural, and Other Open Burning		1,706		1,713
Stationary Internal Combustion Engines				
MOBILE SOURCES				
Highway Vehicles		176,194		68,295
Off-highway Vehicles		12,849		12,792
Rail		6,254		6,275
Aircraft		5,396		4,784
Vessels		1,943		1,792
POINT SOURCE GROWTH			640	
Banked Emissions	410		410	
TOTAL	180,491	316,090	114,941	190,582
GRAND TOTAL	496,581		305,523	

[1]Includes all storage facilities except those at service stations and bulk plants.

[2]Emissions from loading tank trucks and rail cars.

[3]Emissions from storage and transfer operations.

TABLE

SUMMARY TABLE FOR OXIDES OF NITROGEN EMISSIONS*
FOR THE FIVE COUNTY SOUTHEASTERN PENNSYLVANIA REGION

	Base Year 1980 Point	Base Year 1980 Area	Baseline Projection 1987 Point	Baseline Projection 1987 Area
EXTERNAL FUEL COMBUSTION				
Utility Boilers	55,689		55,689	
Industrial Boilers	3,586		3,586	
Commercial, Institutional, Residential	1,698		1,698	
STATIONARY INTERNAL COMBUSTION				
Reciprocating Engines				
Gas Turbines				
INDUSTRIAL PROCESSES				
Chemical Manufacturing				
Other	716		716	
Iron and Steel	10,372		10,372	
Mineral Products				
Cement				
Glass	833		833	
Other	6,035		6,035	
Petroleum Refining	24,931		24,931	
Other	6,760		6,507	
INCINERATION AND OPEN BURNING		469		468
MOBILE SOURCES				
Highway Vehicles		191,864		144,406
Off-highway Vehicles		11,248		11,931
Rail		23,551		24,702
Aircraft		3,700		4,033
Vessels		4,212		4,276
PHILADELPHIA COUNTY POINT SOURCES	60,610		60,610	
POINT SOURCE GROWTH			1,615	
TOTAL	171,230	235,044	172,845	189,816
GRAND TOTAL	406,274		362,661	

*Kilograms per day (kg/day) for a typical summer weekday

PHILADELPHIA AIR MANAGEMENT SERVICES
SUMMARY OF VOLATILE ORGANIC COMPOUND EMISSIONS
FROM POINT SOURCES - KILOGRAMS/DAY

Source Type	Emissions 1980	1987
STORAGE, TRANSPORTATION & MARKETING OF VOC		
Oil and Gas Production & Processing	0	0
Gasoline and Crude Oil Storage	4,893	2,590
Bulk Gasoline Terminals	210	210
Ship & Barge Transfer of VOC	1,818	1,818
Marine Vessel Ballasting	244	244
INDUSTRIAL PROCESSES		
Petroleum Refining	12,010	5,710
Organic Chemical Manufacture	3,947	1,820
Paint Manufacture	449	449
Vegetable Oil Processing	0	0
Pharmaceutical Manufacture	0	0
Plastic Products Manufacture	0	0
Rubber Products Manufacture	36	36
Textile Polymer Manufacture	0	0
Other	1,621	1,320
INDUSTRIAL SURFACE COATING		
Large Appliances	29	29
Magnet Wire	0	0
Automobiles	249	90
Cans	3,106	1,300
Metal Coils	36	36
Paper	899	310
Fabric	0	0
Metal Furniture	356	356
Wood Furniture	52	52
Flat Wood Products	125	125
Other Metal Products	1,311	1,300
Other	712	712
NON-INDUSTRIAL SURFACE COATING		
Auto Refinishing	125	125
Others	218	218
OTHER SOLVENT USE		
Degreasing	1,431	1,040
Drycleaning	145	145
Graphic Arts	525	330
Adhesives	26	26
Other	483	483

Source Type	Emissions 1980	1987
OTHER MISCELLANEOUS SOURCES		
Fuel Combustion	1,884	1,880
Solid Waste Disposal	727	727
TOTAL	37,667	23,481

1980 EMISSION INVENTORY FOR VOLATILE ORGANIC COMPOUNDS FOR THE FIVE COUNTY SOUTHEASTERN PENNSYLVANIA REGION
(kg/day, typical summer weekday)

	TOTAL	BUCKS	CHESTER	DELAWARE	MONTGOMERY	PHILADELPHIA
Solvent Users						
Degreasing	13,676	1,781	1,178	2,065	2,385	6,267
Drycleaning	6,849	890	589	1,043	1,193	3,134
Architectural coatings	20,969	2,731	1,806	3,168	3,655	9,609
Auto body refinishing	12,172	2,023	1,156	1,978	2,532	4,483
Graphic arts	3,646	475	313	552	636	1,670
Commercial/consumer solvent use	28,722	3,740	2,475	4,339	5,007	13,161
Cutback asphalt	2,802	526	535	390	689	662
Solid Waste Disposal						
Structural fires	1,695	221	147	256	293	778
Wildfires	11	4	7	0	0	0
Gasoline Marketing	22,912	4,390	3,224	3,864	6,540	4,894
Highway Mobile Sources	176,194	26,939	19,005	26,595	42,130	61,525
Non-highway Mobile Sources						
Aircraft	5,396	546	154	5	1,483	3,208
Railroad-locomotives	6,254	815	539	944	1,091	2,865
Vessels	1,943	244	31	617	74	977
Small utility engines	11,056	1,360	960	1,684	1,942	5,110
Agriculture	1,132	326	544	27	235	0
Construction equipment	661	142	54	78	228	159
Banked Emissions	410	410	0	0	0	0
POINT SOURCES	180,081	47,167	15,805	67,588	11,854	37,667
TOTALS	496,581	94,730	48,522	115,193	81,967	156,169

1987 EMISSION INVENTORY FOR VOLATILE ORGANIC COMPOUNDS FOR
THE FIVE COUNTY SOUTHEASTERN PENNSYLVANIA REGION
(kg/day, typical summer weekday)

SOURCE	TOTALS	BUCKS	CHESTER	DELAWARE	MONTGOMERY	PHILADELPHIA
Solvent Users						
Degreasing	10,232	1,431	902	1,510	1,801	4,588
Drycleaning	6,863	954	602	1,006	1,243	3,058
Architectural coatings	20,918	2,926	1,846	3,086	3,681	9,379
Auto body refinishing	12,537	2,084	1,191	2,037	2,608	4,617
Graphic arts	3,637	509	321	536	640	1,631
Commercial/consumer solvent use	28,649	4,008	2,528	4,227	5,041	12,845
Cutback asphalt	2,656	504	493	368	654	637
Solid Waste Disposal						
Structural fires	1,701	237	149	249	308	758
Wildfires	12	4	7	0	1	0
Gasoline Marketing	9,439	1,606	1,126	1,424	2,412	2,871
Highway Mobile Sources	68,295	10,581	7,054	9,833	16,459	24,368
Non-highway Mobile Sources						
Aircraft	4,784	595	167	5	948	3,069
Railroad-locomotives	6,275	872	550	920	1,137	2,796
Vessels	1,792	231	31	566	74	890
Small Utility Engines	11,028	1,535	969	1,616	1,987	4,921
Agriculture	1,037	300	500	20	217	0
Construction equipment	727	156	59	86	251	175
Banked Emissions	410	410	0	0	0	0
POINT SOURCES	114,531	22,903	10,736	49,779	7,632	23,481
TOTALS	305,523	51,846	29,231	77,268	47,094	100,084

Reactive + Nonreactive

BUCKS

Source	Firm/Pl. Code	SIC Code	1978 Total Hydrocarbon TPY	1980 Estimated Total Hydrocarbon TPY
Minnesota Mining & Mfg. Co.	41-0417775/01	2641	10,233	12,000
Philadelphia Electric Co.	23-0970240/12	4911	97	97
Brown Co.	23-0945133/01	2641	345	345
Litho-Strip Co.	36-0730380/01	3479	439	439
U. S. Steel Corp.	25-0996816/13	3312	6,464	6,464
American Can Co.	13-0430480/01	3411	756	567
Dyna Cure Pre Coated Steel, Inc.	23-1643359/01	3479	94	94
Rohm & Haas Delaware Valley, Inc.	23-1028370/03	2821	347	347
Prior Coated Metals Co.	25-1029939/02	3479	30	30
Robertson American Corp.	23-1025070/01	3253	107	107
Fasson-Div. of Avery Prod. Corp.	95-1492269/01	2641	984	984
Cleveland Steel Container Corp.	34-0934564/01	3411	178	178
Meenan Oil Co., Inc.	13-5581656/01	5171	27	0
Paramount Packaging Corp.	23-0941360/01	2751	587	587
Superpac Inc.	23-1617849/01	2751	199	199
National Can Corp.	36-2241181/04	3411	806	806
	TOTAL		21,693	23,244

CHESTER

Source	Firm/Pl. Code	SIC Code	1978 Total Hydrocarbon TPY	1980 Estimated Total Hydrocarbon TPY
Lukens Steel Co.	23-0824870/01	3312	8	8
The Budd Co.	23-0443060/05	2821	20	20
SCM Corp.	15-0451820/03	2641	2,801	2,801
Milprint, Inc.	39-0474940/01	2751	1,366	1,366
NVF Co.	51-0035270/02	3079	1,716	86
Philadelphia Electric Co.	23-0970240/04	4911	98	98
Sun Oil Co. of Pa.	23-1743283/04	5171	23	23
Wyeth Laboratories, Inc.	23-1405012/03	2834	40	40
Luria Brothers & Co., Inc.	13-2523465/01	5093	58	58
Continental Flexible Packaging	13-0597410/06	2754	763	763
ICI Americas, Inc.	51-0112320/03	3079	163	163
Diversified Printing Corp.	13-2637726/01	2754	484	484
Atlantic Richfield Co.	23-037161/-03	5171	16	16
Mobil Oil Co.	75-0409450/01	2911	10	10
Sun Pipe Line Co.	23-1139820/01	2911	14	14
	TOTAL		7,580	5,950

DELAWARE

Source	Firm/Pl. Code	SIC Code	1978 Total Hydrocarbon TPY	1980 Estimated Total Hydrocarbon TPY
Sun Ship Building & Dry Dock Co.	23-1136930/01	3731	282	282
Scott Paper Co.	23-1065080/01	2621	15	15
Del. Co. Regional Water Auth.	23-7182698/01	4952	19	19
Boeing Vertol Co.	91-0425694/01	3721	20	20
Gulf Oil Co. - USA	25-0527925/03	2911	231	231
Del. Co. Disposal Department	23-6003046/01	4953	149	0
Philadelphia Electric Co.	23-0970240/01	4911	224	224
Sun Oil Co. of Pa.	23-1743283/12	2911	12,553	12,553
Congoleum Corp.	22-1852666/01	3996	3,441	3,441
Allied Chemical Corp.	13-4918545/05	2819	74	74
Sohio Pipe Line Co. (BP Oil)	34-0540328/01	2911	146	146
Sun Oil Tank Farm No. 2	23-1743283/17	2911	269	269
Sun Oil Co. of Pa.	23-1743283/10	2911	108	108
Laurel Pipe Line Co.	23-1542963/01	2911	294	294
Arco Pipeline Co.	48-0545737/01	4613	728	728
Gulf Oil Co. - USA	25-0527925/10	2911	1,024	1,024
BP Oil Inc.	95-2295416/03	2911	10,130	10,130
Witco Chemical Corp.	13-1870000/02	2818	1,908	1,908
Julian B. Slevin	23-1094770/01	2754	182	182
	TOTAL		25,824	25,675

MONTGOMERY

Source	Firm/Pl. Code	SIC Code	1978 Total Hydrocarbon TPY	1980 Estimated Total Hydrocarbon TPY
Philadelphia Textile Finishers Inc.	23-1426381/01	2295	208	208
Dana Corp.	34-4361040/03	3714	21	21
Sun Mark Industries of Pa.	23-1743283/14	5171	70	70
Nicolet, Inc.	22-1620997/01	3292	69	69
Greene, Tweed & Co.	23-1287953/01	3079	141	141
Doehler-Jarvis Castings Div.	13-5267260/01	3361	68	68
Knoll International Inc.	36-2645676/01	2521	218	218
The Firestone Tire & Rubber Co.	34-0220440/01	3011	3,059	2,461
Container Corp. of America	36-2659288/02	2651	72	72
Merck Sharp & Dohme	22-1109110/01	2834	388	125
Pullman Inc.	36-2418331/02	3715	114	50
Keystone Coke Co.	63-0743064/01	3312	529	132
Container Corp. of America	36-2659288/01	2754	514	514
The B. F. Goodrich Tire & Rubber Co.	34-0252680/01	3011	1,083	1,083
Penco Products, Inc.	23-1607019/01	2542	299	299
Lee Tire & Rubber Co.	23-1653594/01	3011	1,277	0
Synthane-Taylor Corp.	23-1392824/01	3079	8	8
Synthane-Taylor Corp.	23-1392824/03	3079	7	7
Superior Tube Co.	23-1138550/01	3841	84	84
	TOTAL		8,229	5,630

BUCKS

Source	Firm/Pl. Code	1980 Estimated NO_x TPY
Philadelphia Electric Co.	23-0970240/12	1,195
Robertson Amercian Corp.	12-1025070/01	1,618
Rohm & Haas Delaware Valley, Inc.	23-1028370/03	215
Brown Co.	23-0945133/01	76
Minnesota Mining & Mfg. Co.	41-0417775/01	75
A. E. Staley Mfg. Co.	37-0529320/01	343
United States Steel Corp.	25-0996816/13	3,692
	TOTAL	7,214

CHESTER

Source	Firm/Pl. Code	1980 Estimated NO_x TPY
Alan I. W. Frank Corp.	25-1119477/01	120
Brandywine Paper Corp.	23-1577754/01	38
Embreeville State Hospital	23-6003113/07	25
Grocery Store Products Co.	23-1737256/02	21
Pennhurst State School & Hosp.	23-6003113/02	60
West Chester State College	69-023000/26	55
The Davey Co.	23-0510970/01	39
Sonoco Products Co.	23-0534560/02	166
Wyeth Laboratories, Inc.	23-1405012/02	93
Lincoln University	23-1352655/01	23
Wyeth Laboratories, Inc.	23-1405012/03	36
The Budd Co.	23-0443060/05	18
Philadelphia Electric Co.	23-0970240/04	7,110
Warner Co.	23-1194820/01	810
Lukens Steel Co.	23-0824870/01	306
Foote Mineral Co.	23-05895710/01	24
Oxford Royal Mushroom Prod., Inc.	23-1281118/01	15
Phoenix Steel Corp.	13-5520077/01	151
	TOTAL	9,110

DELAWARE

Source	Firm/Pl. Code	1980 Estimated NO_x TPY
Westinghouse Electric Corp.	25-0877540/04	207
Sun Oil Co. of Pa.	23-1743283/12	7,568
Cheyney State College	23-6003115/03	20
Haverford State Hospital	23-6003113/09	50
Delaware Co. Reg. Water Authority	23-7182698/01	77
Crozer-Chester Medical Center	23-1637191/01	36
Witco Chemical Corp.	13-1870000/02	69
Philadelphia Electric Co.	23-0970240/01	12,702
Scott Paper Co.	23-1065080/01	861
Congoleum Corp.	22-1852666/01	101
Philadelphia Electric Co.	23-0970240/02	1,399
Villanova University	23-1352688/01	38
P. Q. Corp.	23-0972750/01	90
Boeing Vertol Co.	91-0425694/01	137
B. P. Oil, Inc.	95-2295416/03	2,463
	TOTAL	25,818

MONTGOMERY

Source	Firm/Pl. Code	1980 Estimated NO_x TPY
Firestone Tire & Rubber Co.	34-0220440/01	200
B. F. Goodrich Tire & Rubber Co.	34-0252680/01	81
Dana Corp.	34-4361040/03	33
Continental Fibre Co.	23-1981752/01	54
S.P.S. Technologies, Inc.	23-6298218/01	32
Keystone Coke Co.	63-0743064/01	26
Simpson Paper Co.	91-0470860/02	199
Certain-Teed Products Corp.	23-1309067/03	48
Cabot Berylco Industries	23-1700349/01	46
Pottstown Memorial Medical Ctr.	23-1668921/01	26
Superior Tube Co.	23-1138550/01	23
Rohm & Haas Delaware Valley Inc.	23-1028370/01	32
Synthane-Taylor Corp.	23-1392824/01	86
Synthane-Taylor Corp.	23-1392824/03	24
Graterford Penitentiary	23-1733023/01	66
Norristown State Hospital	23-1733023/02	100
Bryn Mawr Hospital	23-1352160/01	39
Merck Sharp & Dohme	22-1109110/01	163
Stanley G. Flagg & Co.	23-0585350/01	87
Doehler-Jarvis Castings Div.	13-5267260/01	633
Diamond Glass Co.	23-0523450/01	335
Nicolet, Inc.	22-1620997/01	32
	TOTAL	2,365

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Minnesota Mining & Mfg. Co.

SIC Code: 2641

Location: Bristol Township, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
1-E Coater & Oven No. 4	1,297	1,521
2-E Coater & Oven No. 5	5,514	6,466
3-E Coater & Oven No. 6	2,816	3,302
4-E Treater & Oven No. 7	1,356	1,590
5-E Treater & Oven No. 8	171	200
1-W Coater & Oven No. 9	1,890	2,216
2-W Coater & Oven No. 10	4,265	5,001
3-W Coater & Oven No. 11	3,433	4,026
4-W Treater & Oven No. 12	531	623
#2 Rubber Mill So. Rm.	22	26
#1 Rubber Mill N. Rm.	7	8
Mogul Mixer, Rm-5	5	6
Mogul Mixer, Rm-8	11	13
Mogul Mixer, Rm-11	6	7
5W Coater & Oven No. 26	3,339	3,916
Banbury Pelletizer System	1	1
Blender (1400), Rm-9	68	80

Churn (1600), Rm-9	131	154
Blender, Room #2 [126]	40	47
Blender, Room #2 [127]	40	47
Blender, Room #3	58	68
Blender, Room #4 [129]	59	69
Blender, Room #4 [130]	59	69
Churns, Room #3 (4)	62	73
Churns, Room #13 (9)	58	68
Churns, Room #14 (9)	87	102
Churns, Room #15 (4)	19	22
Kettle, Room #1 [135]	17	20
Kettle, Room #1 [136]	14	16
Mogul Mixer, Rm-6	15	18
Blender, Rm-6	7	8
Kady Mill, Rm-7	2	2
Blender, Rm-7	63	74
Churn, Rm-7 (1200)	52	61
Churn (500), Rm-7	19	22
Mogul (500), Rm-10	15	18
Blender (650), Rm-10	43	50
Mogul (400), Rm-12	15	18
Total	25,607	30,028

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Philadelphia Electric Co.

SIC Code: 4911

Location: Bristol Township, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Croyden - Turbine #11	21	21
Croyden - Turbine #12	22	22
Croyden - Turbine #21	11	11
Croyden - Turbine #22	11	11
Croyden - Turbine #31	18	18
Croyden - Turbine #32	24	24
Croyden - Turbine #41	22	22
Croyden - Turbine #42	0	0
Total	129	129

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Brown Co.

SIC Code: 2641

Location: Bristol Township, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Silicone Coating	455	455
Paper Parchmentizing #1	95	95
Paper Parchmentizing #2	98	98
Paper Parchmentizing #3	51	51
Paper Parchmentizing #4	135	135
Paper Parchmentizing #5	114	114
Total	948	948

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Litho-Strip Co.

SIC Code: 3479

Location: Falls Township, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Coil Coating, Primer	949	949
Coil Coater, Finishing	316	316
Total	1,265	1,265

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

United States Steel Corp.

SIC Code: 3312

Location: Falls Township, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)	
Coke Battery No. 1, Charging	763	763	8841
Coke Battery No. 1, Coking	2,084	2,084	2
Coke Battery No. 1, Pushing	61	61	1031
Coke Battery No. 2, Charging	763	763	5
Coke Battery No. 2, Coking	457	457	1656
Coke Battery No. 2, Pushing	61	61	12
Sinter Machine No. 1, Windbox	536	536	
Sinter Machine No. 2, Windbox	565	565	2 5
Open Hearth No. 1	59	59	37
80 In. H.S. Re. Ht. X 4 1	21	21	45
Bloom Mill Re. Fc. 2 Fce	3	3	690
Galvanizing Line, Furnace	2	2	834
Rod Mill Reheat Furnace	3	3	
Skelp Reheat Furnace	3	3	
Light Oil Storage Tank	4	4	
Power House Boiler No. 3	2	2	
Power House Boiler No. 4	2	2	

Power House Boiler No. 5	2	2
Power House Boiler No. 6	2	2
Total	5,393	5,393

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

American Can Co.

SIC Code: 3411

Location: Falls Township, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Litho Press & Oven #11	13	10
Litho Press & Oven #12	14	11
Litho Press & Oven #13	42	32
Litho Press & Oven #14	42	32
Litho Press & Oven #15	43	32
Coater & Oven #16	191	143
Coater & Oven #17	16	12
Coater & Oven #18	208	156
Coater & Oven #19	172	129
Coater & Oven #20	208	156
Coater & Oven #21	32	24
Can Line Spray & Oven #10	36	27
Can Line Spray & Oven #11	32	24
Can Line Spray & Oven #12	37	28
Gang Press - Liners-#61	57	43
Gang Press - Liners-#62	61	46
Gang Press - Liners-#63	97	73

Gang Press - Liners-#64	74	56
Double Die Liners #201	37	28
Double Die Liners #202	46	35
Double Die Liners #203	29	22
Double Die Liners #204	37	28
Double Die Liners #205	42	32
Double Die Liners #206	37	28
Single Die Liner #211	11	8
Double Die Liners #216	47	35
Double Die Liners #217	39	29
Double Die Liners #218	30	23
Double Die Liners #219	44	33
Double Die Liners #220	31	23
Double Die Liners #228	0	0
Double Die Liners #207	34	26
Double Die Liners #208	75	56
Total	1,914	1,440

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Dyna Cure Pre-Coated Steel, Inc.

SIC Code: 3479

Location: Bensalem Township, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
30 In. Coil Coater	235	235
6 Inc. Coil Coater	5	5
Total	240	240

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Rohm & Haas Delaware Valley, Inc.

SIC Code: 2821

Location: Bristol Borough, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
I2, Poly Gran. Transfer	2	2
J1 Spec. Color Extruder	4	4
J3 S. Color Extruder QNC	4	4
K1 MMA Still No. 1	18	18
K2 MMA Still NO. 2	13	13
K3 MMA Still No. 3	25	25
K4 MMA Still No. 4	13	13
K5 MMA Still No. 5	7	7
K6 MMA Still No. 6	1	1
L7 Silo Storage System	36	36
L9 Storage Silo	36	36
M1 Petro Add, 3-Poly Kettle	70	70
M2 Petro Add, (2) Poly Kettle	8	8
M8, Petro Add, 5 Kettles	11	11
M12, Petro Add, 2 Blend T	0	0
O1, Polmyer Kettle-4	2	2
O6, Polymer Kettle	0	0

O7, Dilution Kettle	2	2
O3, Drumming Station	13	13
O4, Drumming Station	74	74
P3 Transester, Reactor	8	8
P2 Transester, Filter	3	3
P1 Transester, Still	4	4
Q1(2) Polymerization Kit	15	15
Q2 Emulsion Mix Tanks - 2	8	8
R1, Insecticide Reactor	1	1
R2, Conversion Kettles - 2	2	2
R4, Insecticide Reactor	7	7
R5, Insecticide Still	5	5
S3, Fungicide, Still	27	27
R6, Drying Tanks - 2	7	7
S1, Fungicide, Reactor	7	7
S2, Fungidice, Reactor	8	8
T1, Cast Sheet, 50 Ovens	94	94
T2, Cast Sheet, 8 Pots	3	3
V1, Fermentation Kettles -4	12	12
W3(3) Polymerization Kettle	1	1
W5 Emulsion Mix Tanks - 2	1	1
X1 Acrylic Extruders - 4	11	11
AA4 (5) Bulk Poly Mix Tank	8	8
AA1 (4) Bulk Poly Fill TA	4	4
AA2 Bulk Poly Ovens - 11	32	32
BB1 (3) Organ. Acid Still	16	16
CC1 Pwdr. Vinyl Mod, Dryer	82	82
FF1 Mix Room Exhaust	14	14

FF2 Former Exhaust	15	15
FF3 4 Tanks, Exhaust	15	15
FF7 Former Vacuum System	12	12
FF9 Additive Tanks - 4	1	1
FF12, Former Die Exhaust	0	0
C, Comb. Engr. No. 7	3	3
C, Comb. Engr. No. 8	1	1
Total	766	766

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Prior Coated Metals Co.

SIC Code: 3479

Location: Morrisville Borough, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Paint Bake Oven - Primer	2	2
Paint Bake Oven - Finish [102]	46	46
Paint Bake Oven - Finish [102A]	30	30
Total	78	78

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Roberston American Corp.

SIC Code: 3253

Location: Morrisville Borough, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Union Boiler 185 H.P.	0	0
Total	0	0

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Fasson - Div. of Avery Prod. Corp.

SIC Code: 2641

Location: Quakertown Borough, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Q1 Coater (80 in. width)	1,275	1,275
Q2 Coater (60 in. width)	658	658
No. 1 Mixing Churn	115	115
No. 2 Mixing Churn	115	115
No. 3 Mixing Churn	19	19
No. 5 Mixing Churn	28	28
#4 Mixing Churn	5	5
#6 Mixing Churn	72	72
Total	2,287	2,287

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Cleveland Steel Container Corp.

SIC Code: 3411

Location: Quakertown Borough, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Bottom Flange Spray	27	27
Bottom Spray	3	3
Pail Line Paint Booth	133	133
Pail Line Oven	248	248
Roll Coater - Smell Hood	20	20
Roll Coater - Oven	38	38
Pail Side Seam Spray	0	0
Total	469	469

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Meenan Oil Co., Inc.

SIC Code: 5171

Location: Tullytown Borough, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Gasoline Storage Tank #1	6	0
Truck Loading - Gasoline	51	0
Gasoline Storage Tank #2	12	0
Total	69	0

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Paramount Packaging Corp.

SIC Code: 2751

Location: Chalfont Borough, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Flexographic Press No. 121	234	234
Flexographic Press No. 122	234	234
Flexographic Press No. 123	234	234
Flexographic Press No. 124	234	234
Flexographic Press No. 125	234	157
Flexographic Press No. 126	157	157
Flexographic Press No. 127	157	157
Total	1,484	1,484

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Superpac Inc.

SIC Code: 2751

Location: Upper Southampton Township, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Flexographic Stack Press	126	126
Flexographic Print Press [102]	189	189
Flexographic Print Press [103]	189	189
Total	504	504

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

National Can Corp.

SIC Code: 3411

Location: Falls Township, Bucks County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Coater and Oven Line #1	366	366
Coater & Oven Line #2	264	264
Coater & Oven Line #3	366	366
Coater & Oven Line #4	366	366
Litho Press Line #5	47	47
Litho Press Line #6	47	47
Litho Press Line #7	47	47
Litho Press Line #8	47	47
12 End Seal Comp. Liners	586	586
Total	2,136	2,136

* Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Lukens Steel Co.

SIC Code: 3312

Location: Coatesville Borough, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Nab. Furn., Cont. Ht. Tr.	2	2
Misc. Procs. & Gas Use (10)	6	6
Total	8	8

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

The Budd Co. - Plastic Products Division

SIC Code: 2821

Location: Phoenixville Borough, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Treater	4	4
Curing Oven #1	7	7
Curing Oven #2	33	33
Curing Oven #3	7	7
Total	51	51

*Typical Summer Day for 1978

TABLE ___

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

SCM Corp., Allied Paper Div.

SIC Code: 2641

Location: Phoenixville Borough, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Coated Paper Dryer	6,791	6,791
Total	6,791	6,791

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Milprint, Inc.

SIC Code: 2751

Location: Downingtown Borough, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Rotogravure Printing #220	256	256
Rotogravure Printing #938	121	121
Rotogravure Printing #572	211	211
Rotogravure Printing #281	91	91
Rotogravure Printing #599	429	429
Rotogravure Printing #571	233	233
Flexo Printing #566	139	139
Flexo Printing #399	309	309
Flexo Press #398	120	120
Flexo Printing #397	198	198
Flexo Printing #265	240	240
Extruder #235	827	827
Extruder #264	465	465
Laminator #575	74	74
Laminator #598	150	150
Total	3,863	3,863

*Typical Summery Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

NVF Co.

SIC Code: 3079

Location: Kennett Square Borough, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
#6 Coater & Oven	120	120
#7 Coater & Oven	177	177
#8 Coater & Oven	88	88
#9 Coater & Oven	177	177
#10 Coater & Oven	14	14
#11 Coater & Oven	177	177
#12 Coater & Oven	227	227
#13 Coater & Oven	126	126
#14 Coater & Oven [109A]	164	164
#15 Coater & Oven [110A]	164	164
Total	1,434	1,434

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Philadelphia Electric Co.

SIC Code: 4911

Location: East Pikeland Township, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Boiler #1	119	119
Boiler #2	70	70
1 #6	11	11
D 2	11	11
Total	211	211

*Typical Summer Day for 1978

TABLE ____

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Sun Oil Co. of Pa.

SIC Code: 5171

Location: East Whiteland Township, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Tank #10 (covered floater)	8	8
Tank #12 (covered floater)	2	2
Tank #13 (covered floater)	4	4
Tank #14 (covered floater)	2	2
Gasoline Trk. Loading Rack	43	43
Total	59	59

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Wyeth Laboratories, Inc.

SIC Code: 2834

Location: East Whiteland Township, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Tablet Polishing Pans	8	8
Sprary Coating Pan (Lab)	1	1
Isordil Processor	1	1
Ovral Processor	2	2
Spray Coating Pan (A-C)	30	30
Spray Coating Pan (PIB)	3	3
Total	45	45

*Typical Summer Day for 1978

TABLE ______

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Luria Brothers & Co., Inc.

SIC Code: 5093

Location: South Coatesville Borough, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Drum Dryer	83	83
Total	83	83

*Typical Summer Day for 1978

TABLE ______

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Continental Flexible Packaging

SIC Code: 2754

Location: Tredyffrin Township, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
#8 Zerande Gravure Press	1,565	1,565
#6 Faustel Flexo Press	52	52
#55 Kidder Flexo Press	22	22
#17 Hoe Letter Press	15	15
Letter Press #16	15	15
Letter Press #15	7	7
Letter Press #11	11	11
Letter Press #65	8	8
Total	1,695	1,695

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

ICI Americas, Inc.

SIC Code: 3079

Location: West Goshen Township, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Drying Oven #1	10	10
Drying Oven #2 [102]	104	104
Drying Oven #2 [102A]	10	10
Drying Oven #3 (white) [103]	52	52
Drying Oven #3 (white) [103A]	5	5
Drying Oven #4 (Dark) [104]	52	52
Drying Oven #4 (Dark) [104A]	5	5
Total	238	238

*Typical Summer Day for 1978

TABLE ________

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Diversified Printing Corp.

SIC Code: 2754

Location: West Sadsbury Township, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Motter, Rotogravure, Press	199	199
HOE, Rotogravure, Press #2	199	199
HOE, Rotogravure, Press #3	199	199
Motter, Rotogravure, Press #4	199	199
Rotogravure Proof Press	142	142
Flexo. Imprinter No. 1	71	71
Flexo. Imprinter No. 2	71	71
Flexo. Imprinter No. 3	71	71
Flexo. Imprinter No. 4	71	71
Total	1,222	1,222

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Atlantic Richfield Co.

SIC Code: 5171

Location: West Whiteland Township, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Storage Tank #1	2	2
Storage Tank #2	1	1
Storage Tank #3	3	3
Storage Tank #4	1	1
Storage Tank #5	2	2
Storage Tank #8	7	7
Loading Rack - Gasoline	25	25
Total	41	41

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Mobil Oil Co.

SIC Code 2911

Location: East Whiteland Township, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Gasoline Loading Racks	3	3
Tank #3 (Covered Floater)	1	1
Tank #103	7	7
Tank #104	7	7
Tank #105	8	8
Tank #2 (Covered Floater)	2	2
Total	28	28

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Sun Pipe Line Co.

SIC Code: 2911

Location: West Brandywine Township, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
#1 Covered Floater Tank	12	12
#3 Covered Floater Tank	12	12
#4 Open Floater Tank	12	12
Total	36	36

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Sun Ship Building & Dry Dock Co.

SIC Code: 3731

Location: Chester City, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Binks Paint Spray Unit	58	58
Binks Paint Spray Encl.	7	7
Ship Spray Painting	322	322
Total	387	387

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Scott Paper Co.

SIC Code: 2621

Location: Chester City, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Resin Manufacture	1	1
No. 19 Paper Machine	5	5
Boiler No. 6	4	4
Boiler No. 7	4	4
Boiler No. 8	15	15
Boiler No. 9	4	4
Total	33	33

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Delaware County Regional Water Authority

SIC Code: 4952

Location: Chester City, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Nichols - Herreshoff (Incinerator)	19	19
Nichols - Herreshoff (Incinerator)	19	19
Total	38	38

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Boeing Vertol Co.

SIC Code: 3721

Location: Ridley Township, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Paint Spray Bldg. 3-12	18	18
Paint Spray 3-565	7	7
Paint Spray Bldg. 3-79 [171]	1	1
Paint Spray Bldg. 3-80 #1	8	8
Paint Spray Bldg. 3-80 #2	8	8
Paint Spray Bldg. 3-79	2	2
Paint Spray Bldg. 3-80 #3	1	1
Total	45	45

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Gulf Oil Co. - U.S.A.

SIC Code: 2911

Location: Darby Township, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
DC-1 Open Floater Tank	18	18
DC-2 Open Floater Tank	18	18
DC-3 Open Floater Tank	18	18
DC-4 Open Floater Tank	18	18
DC-5 Open Floater Tank	18	18
DC-6 Open Floater Tank	18	18
DC-7 Open Floater Tank	18	18
DC-8 Open Floater Tank	18	18
DC-10 Open Floater Tank	18	18
DC-11 Open Floater Tank	18	18
DC-12 Open Floater Tank	18	18
DC-13 Open Floater Tank	19	19
DC-14 Open Floater Tank	0	0
DC-15 Open Floater Tank	15	15
DC-16 Open Floater Tank	0	0
DC-17 Open Floater Tank	0	0
DC-18 Open Floater Tank	0	0

DC-19 Open Floater Tank	12	12
DC-20 Open Floater Tank	18	18
DC-21 Open Floater Tank	18	18
DC-22 Open Floater Tank	18	18
DC-23 Open Floater Tank	18	18
DC-24 Open Floater Tank	18	18
DC-25 Open Floater Tank	18	18
DC-26 Open Floater Tank	18	18
DC-27 Open Floater Tank	18	18
DC-28 Open Floater Tank	18	18
DC-29 Open Floater Tank	18	18
DC-30 Open Floater Tank	18	18
DC-31 Open Floater Tank	18	18
DC-32 Open Floater Tank	18	18
DC-33 Open Floater Tank	18	18
DC-4 Waste Water Separator	98	98
Total	594	594

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Delaware County Disposal Dept.

SIC Code: 4953

Location: Chester Township, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
#1 Furnace	127	0
#2 Furnace	127	0
#3 Furnace - Rotary Kiln	123	0
Total	377	3770

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Philadelphia Electric Co.

SIC Code: 4911

Location: Eddystone Borough, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
No. 1 Boiler	200	200
No. 2 Boiler	213	213
No. 3 Boiler	77	77
Auxiliary Boiler [A]	3	3
Auxiliary Boiler [B]	3	3
Auxiliary Boiler [C]	3	3
No. 10 Gas Turbine	1	1
No. 20 Gas Turbine	1	1
No. 30 Gas Turbine	1	1
No. 40 Gas Turbine	1	1
No. 4 Boiler	71	71
Total	574	574

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Sun Oil Co. of PA.

SIC Code: 2911

Location: Marcus Hook Borough, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Plt. 10-4 FCC Unit	5,210	5,210
Plt. 17 Benzene Loading	0	0
12 Plant Flare	27	27
10 Plant Flare	33	33
Pipeline Valves and Flanges	1,846	1,846
Vessel Relief Valves	714	714
Compressor Seals	376	376
Purging, Sampling, etc.	752	752
Process Drains and H_2O Sep's	572	572
Vacuum Jets	1,355	1,355
Marine Vessel Loading	1,399	1,399
Pump Seals	1,280	1,280
37 Open Floaters	711	711
40 Covered Floaters	189	189
PH-8 Boiler	2	2
PH-9 Boiler	2	2

PH-10 Boiler	5	5
10-4 Recycle Heater	3	3
12-3 Vac Heater	2	2
12-3 RC Heater	7	7
15-1 #1 Heater	9	9
15-1 #2 Heater	2	2
17-1, H-1 Heater	2	2
17-1A, H-101 Heater	5	5
15-BH-1 Boiler	3	3
15-BH-2 Boiler	3	3
15-BH-3 Boiler	3	3
15-BH-4 Boiler	3	3
15-BH-5 Boiler	5	5
15-BH-6 Boiler	11	11
15-BH-7 Boiler	18	18
Fugitive Leaks	5,084	5,084
Total	19,633	19,633

*Typical Summer Day of 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Congoleum Corp.

SIC Code: 3996

Location: Marcus Hook Borough, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Bldg. 28 Fusion Line	1,835	1,835
Bldg. 50 Fusion Oven	1,264	1,264
No. 110 Gelling Oven	1,545	1,545
Bldg. 121 Curing Oven	456	456
Bldg. 28 Roto-Press	1,780	1,780
Bldg. 121 Roto-Press	1,810	1,810
Total	8,690	8,690

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Allied Chemical Corp.

SIC Code: 2819

Location: Marcus Hook Borough, Chester County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Spray Dryer Reactor	5	5
Batch Process - Bldg. 31 [117]	11	11
Batch Process - Bldg. 31 [118]	11	11
Batch Processes [120]	5	5
Batch Process [121]	5	5
Batch Reactor	5	5
Batch Processes [123]	5	5
Batch Processes [130]	5	5
Batch Processes [131]	8	8
Batch Processes [132]	11	11
Dryer [133]	6	6
Dryer [134]	9	9
Paint Spray Booth	1	1
Bldg. 19 Ventilation	53	53
Bldg. No. 8 Ventilation	9	9
Packaging Mach. No. 1	26	26
Packaging Station No. 1	3	3

Packaging Station No. 2	3	3
Hand Packaging Line No. 1	1	1
Fluid Packaging Line	1	1
Solvent Packaging - Drums	9	9
Total	192	192

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Sohio Pipe Line Co. (BP Oil)

SIC Code: 2911

Location: Upper Chichester Township, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Tank No. 700	58	58
Tank No. 701	2	2
Tank No. 702	2	2
Tank No. 703	54	54
Tank No. 704	2	2
Tank No. 706	58	58
Tank No. 707	58	58
Tank No. 708	3	3
Tank No. 709	63	63
Tank No. 710	63	63
Tank No. 711	2	2
Tank No. 715	3	3
Total	368	368

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Sun Oil Co. Tank Form No. 2

SIC Code: 2911

Location: Upper Chichester Township, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Tank No. 312	35	35
Tank No. 317	35	35
Tank No. 321	73	73
Tank No. 322	54	54
Tank No. 323	54	54
Tank No. 324	54	54
Tank No. 325	11	11
Tank No. 326	11	11
Tank No. 327	54	54
Tank No. 328	54	54
Tank No. 329	54	54
Tank No. 331	54	54
Tank No. 332	86	86
Tank No. 333	38	38
Tank No. 126	11	11
Total	678	678

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Sun Oil Co. of PA.

SIC Code: 2911

Location: Upper Chichester Township, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Gasoline Loading Rack	211	211
Tank No. 2 (Float RF.)	18	18
Tank No. 1 (Cone RF.)	3	3
Tank No. 3 (Float RF.)	14	14
Tank No. 4 (Float RF.)	15	15
Fuel Oil Loading Rack	11	11
Total	272	272

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Laurel Pipe Line Co.

SIC Code: 2911

Location: Bethel Township, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Tank No. 1	11	11
Tank No. 2	11	11
Tank No. 3	12	12
Tank No. 4	12	12
Tank No. 5	11	11
Tank No. 6	15	15
Tank No. 7	11	11
Tank No. 8	12	12
Tank No. 9	69	69
Tank No. 10	81	81
Tank No. 11	86	86
Tank No. 12	69	69
Tank No. 13	69	69
Tank No. 14	73	73
Tank No. 15	59	59
Tank No. 16	38	38
Tank No. 17	38	38

Tank No. 18	15	15
Tank No. 19	51	51
Total	743	743

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

ARCO Pipeline Co.

SIC Code: 4613

Location: Tinicum Township, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Tank No. 851	21	21
Tank No. 852	21	21
Tank No. 853	20	20
Tank No. 854	20	20
Tank No. 855	20	20
Tank No. 856	20	20
Marine Vessel Ballasting	1,717	1,717
Total	1,839	1,839

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Gulf Oil Co. - U.S.A.

SIC Code: 2911

Location: Tinicum Township, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Tanker Ballasting	2,587	2,587
Marine Vessel Loading	-	122
Total	2,587	2,709

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

BP Oil, Inc.

SIC Code: 2911

Location: Trainer Borough, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
FCC Unit	2,072	2,072
Main Flare	78	78
Marine Vessel Ballasting	1,699	1,699
Marine Vessel Loading	2,483	2,483
Process Drains	510	510
Vessel Relief Valves	739	739
Pipeline Valves and Flanges	1,231	1,231
Compressor Seals	220	220
IC Engines—FCCU Comp. (5)	674	674
Cooling Towers	671	671
Blending and Sampling	671	671
Vacuum Jets - 3 Units	3,357	3,357
Blind Charging	20	20
#54A Cone Roof Tank	3,243	3,243
67A Open Floater Tank	10	10
#96 Open Floater Tank	11	11

#99A Cone Roof Tank	1	1
#132A Open Floater Tank	20	20
#151A Open Floater Tank	10	10
#152A Covered Floater Tank	27	27
#153A Open Floater Tank	52	52
#155A Covered Floater Tank	27	27
#156A Open Floater Tank	52	52
#157 Open Floater Tank	51	51
#159 Open Floater Tank	51	51
#161A Open Floater Tank	40	40
#162A Open Floater Tank	12	12
#163A Open Floater Tank	12	12
#164A Open Floater Tank	12	12
#165A Open Floater Tank	12	12
#166A Open Floater Tank	12	12
#168A Covered Floater Tank	29	29
#169 Open Floater Tank	53	53
#170 Open Floater Tank	53	53
#171A Open Floater Tank	55	55
#172 Open Floater Tank	55	55
#174 Open Floater Tank	17	17
#175 Open Floater Tank	12	12
#178 Open Floater Tank	12	12
#179 Cone Roof Tank	14	14
#180 Open Floater Tank	12	12
#181 Open Floater Tank	38	38
#182 Open Floater Tank	38	38

#184 Open Floater Tank	16	16
#185 Open Floater Tank	17	17
#186 Open Floater Tank	17	17
Pump Seals	1,123	1,123
32 Open Floaters	816	816
36 Cone Roof Tanks	68	68
#6 Boiler	5	5
#7 Boiler	8	8
#8 Boiler	7	7
Platformer Feed Heater	17	17
LCD 543 Crude Heater	4	4
ACD 544 Crude Heater	4	4
Fugitive Leaks	5,011	5,011
Total	25,527	25,527

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Witco Chemical Corp.

SIC Code: 2818

Location: Trainer Borough, Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Sulfonic Acid Mfr.	3,738	3,738
Sufonate Mfr.	1,074	1,074
Erie City Boiler No. 1	2	2
Total	4,814	4,814

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Julian B. Slevin

SIC Code: 2754

Location: Delaware County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Printing Operations	452	452
Total	452	452

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Philadelphia Textile Finishers, Inc.

SIC Code: 2295

Location: Norristown Borough, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Finishing Coater #1	295	295
Finishing Coater #2	295	295
Total	590	590

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Dana Corp., Spicer Univ'l Joint Div.

SIC Code: 3714

Location: Pottstown Borough, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Bearing Race Degreaser	47	47
Paint Spray Booth	8	8
Total	55	55

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Sun Mark Industries of Pennsylvania

SIC Code: 5171

Location: Upper Moreland Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Tank #1 Covered Floater	2	2
Tank #2 Covered Floater	3	3
Tank #3 Covered Floater	3	3
Tank #4 Covered Floater	3	3
Tank #5 Open Floater	19	19
Tank #9 Open Floater	16	16
Tank #10 Cone Roof	31	31
Tank #11 Covered Floater	8	8
Gasoline Loading Rack	92	92
Total	177	177

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Nicolet, Inc.

SIC Code: 3292

Location: Ambler Borough, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Sheeter No. 1	42	42
Sheeter No. 2	42	42
Sheeter No. 3	42	42
Sheeter No. 4	42	42
No. 4 Saturating Tanks	5	5
5 Saturating Tanks	5	5
Total	178	178

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Greene, Tweed & Co.

SIC Code: 3079

Location: North Wales Borough, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Coating Tower	347	347
Mark X	8	8
Total	355	355

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Doehler - Jarvis Castings Div.

SIC Code: 3361

Location: West Pottsgrove Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Aluminum Casting Area	140	140
#4 Paint Spray Booths	17	17
Electro. Paint Spray Booths	13	13
Total	170	170

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Knoll International, Inc.

SIC Code: 2521

Location: East Greenville Borough, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Spray Booth #7	115	115
Spray Booth #8	115	115
Spray Booth #9	115	115
Spray Booth #10	58	58
Paint Dry Oven	20	20
Drying Oven #12	2	2
Drying Oven #13	1	1
Curing Oven #14	1	1
Spray Booth #23	21	21
Spray Booth #24	34	34
Spray Booth #25	34	34
Spray Booth #30	34	34
Veneer Press #26	2	2
Veneer Press #27	3	3
Veneer Press #28	3	3
Veneer Dryer #29	3	3
Lacquer Finishing #34	3	3

Lacquer Finishing #35	3	3
Contro- Sunbeam [incinerator]	11	11
Total	518	518

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

The Firestone Tire and Rubber Co.

SIC Code: 3011

Location: Lower Pottsgrove Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
#1 Plastics Banbury	10	0
#1 Plastics Banbury Mill	10	0
#1 Calender Feed Mill	10	0
#1 Plastics Calender	10	0
#2 Plastics Banbury	19	0
#2 Plastics Banbury Mill	19	0
#2 Calender Feed Mill	19	0
#2 Plastics Calender	19	0
#3 Plastics Banbury	17	0
#3 Plastics Banbury Mill	17	0
#3 Calender Feed Mill	17	0
#3 Plastics Calender	17	0
#4 Plastics Banbury	18	0
#4 Plastics Banbury Mill	18	0
#4 Calender Feed Mill	18	0
#4 Plastics Calender	18	0
Diisodecyl Heating Tank	0	0

#1 Banbury Mxr. Drop Gate	3	0
#2 Banbury Mxr. Drop Gate	2	0
#3 Banbury Mxr. Drop Gate	3	0
#4 Banbury Mxr. Drop Gate	3	0
#5 Banbury Mxr. Drop Gate	5	0
#6 Banbury Mxr. Drop Gate	5	0
#7 Banbury Mxr. Drop Gate	5	0
#8 Banbury Mxr. Drop Gate	5	0
#9 Banbury Mxr. Drop Gate	3	0
#10 Banbury Mxr. Drop Gate	1	0
#11 Banbury Mxr. Drop Gate	1	0
Baker Perkins Cmt. Mixer	2	0
Cement Bldg. - Mixing Area	20	0
Cmnt. Bldg. - Drum Fill. Area	20	0
#1 Tread Tuber - Cemt Appl	273	0
#2 Tread Tuber - Cemt. Appl	317	0
#2 Tread Tuber - Cemt. Appl.	273	0
W.S.W. Ext Line Cemt. Appl	376	0
Green Tire Pntng. Booth #1	122	0
Green Tire Pntng. Booth #2	122	0
Green Tire Pntng. Booth #3	122	0
Green Tire Pntng. Unit #4	122	0
H.D. Green Tire Paint Booth	18	0
Radial Tire Spray Booth	29	0
Radial Tire Spray - Q line	51	0
Tire Curing Prss. A line	7	0

Tire Curing Prss. B line	7	0
Tire Curing Prss. C line	7	0
Tire Curing Press D line	7	0
Tire Coating Press G line	7	0
Tire Curing Press J line	7	0
Tire Curing Press K line	7	0
Tire Curing Press L line	7	0
Tire Curing Press M line	7	0
Tire Curing Press N line	7	0
Tire Curing Press O line	7	0
Tire Curing Press P line	7	0
Tire Curing Press Q line	7	0
Tire Curing Press R line	7	0
Tire Curing Press S line	7	0
Tire Curing Press - Industrial	7	0
Bead Dipping Unit	282	0
Tire Building Operation	838	0
Disp. Homs. Poly. and Strip	860	860
#3 Spray Dryer Disp Homo	374	374
#3 Line Hopper	374	374
#3 Spray Dryer Grinder	374	374
#4 Spray Dryer Disp Homo.	115	115
#4 Spray Dryer Disp Coply	28	28
#4 Line Hopper [906]	115	115
#4 Line Hopper [906 S]	95	95
#4 Line Hopper [907 S]	95	95

#4 Spray Dryer - Grinder	114	114
#7 Spray Dryer Disp Homo	74	74
#8 Spray Dryer Disp Homo	63	63
#8 Line Hopper	63	63
#6 Spray Dryer Disp Homo	209	209
Susp. Homo-Poly & Strip	122	122
Susp. Homo Rotary Dryer 11	210	210
#11 Line Hopper	210	210
Susp. Homo Rotary Dryer 12	10	10
Susp. Copoly Rotary Dry 12	15	15
#12 Line Hopper [935]	10	10
#12 Line Hopper [935 S]	15	15
Susp. Copoly Poly & Strip	152	152
Susp. Copoly. Flash Dryer	25	25
Susp. Copoly Rotary Dry 5	25	25
Susp. Copoly Rotary Dry 13	114	114
#13 Line Hoppers	114	114
Latex Poly. & Strip.	0	0
Boiler No. 3	2	2
Boiler #4	7	7
Total	7,375	3,984

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Container Corporation of America

SIC Code: 2651

Location: Upper Gwynedd Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
No. 501 Gravure Press	175	175
8 Color Rotogravure Press	8	8
Total	183	183

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Merck Sharp & Dohme

SIC Code: 2834

Location: Upper Gwynedd Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
10 Soln. Tanks Bldg. 69 [201]	3	1
10 Soln. Tanks Bldg. 69 [202]	3	1
Coating Pan Bldg. 69x30	511	165
Glenn Mixer X6	32	10
Fluid Bed Dryer X6 [216]	59	19
Fluid Bed Dryer X6	7	2
Continuous Processor	16	5
Erie City Boiler	3	1
Total	634	204

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Pullman, Inc.

SIC Code: 3715

Location: Upper Gwynedd Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Spray Booth - Chassis	125	55
Spray Booth Sub-Assembly	75	33
Brake Drum Degreaser	10	4
Touch Up Painting	69	30
Oven Heater	10	4
Total	289	126

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Keystone Coke Co.

SIC Code: 3312

Location: Upper Merion Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
#3 Coke Oven Chg.	173	43
#3 Coke Oven Push	14	3
#3 Coke Oven Door Leaks	104	26
#4 Coke Oven Charging	173	43
#4 Coke Oven Push	14	3
#4 Coke Oven Door Leaks	104	26
Total	582	144

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Container Corporation of America

SIC Code: 2754

Location: Upper Providence Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
#51 Gravure Press	672	672
No. 50 Gravure Press	627	627
Total	1,299	1,299

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point
Sources of Reactive VOC Emissions for the
Five County Southeastern Pennsylvania Region

The B. F. Goodrich Tire & Rubber Co.

SIC Code: 3011

Location: Upper Providence Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
#1-1 Mill Hood, Banbury #1	11	11
#1-3 Mill Hood, Banbury #1	11	11
#1-4 Mill Hood, Banbury #1	11	11
#1-2 Mill Hood, Banbury #1	10	10
#5-1 Mill Hood, Banbury #2	10	10
#5-2 Mill Hood, Banbury #2	10	10
#5-4 Mill Hood, Banbury #2	10	10
#5-3 Mill Hood, Banbury #2	10	10
#7-1 Mill Hood, Banbury #3	10	10
#7-3 Mill Hood, Banbury #3	10	10
#7-4 Mill Hood, Banbury #3	10	10
#7-2 Mill Hood, Banbury #3	10	10
#1 Tread Unit Cementer	417	417
#1 Tread Unit Swabbing	20	20
#2 Tread Unit Cementer	417	417
#2 Tread Unit Swabbing	20	20
40 Gal. Pony Churn Mixer [155]	10	10

40 Gal. Pony Churn Mixer [156]	10	10
40 Gal. Pony Churn Mixer [157]	10	10
Small Mixer	10	10
2 Calender	76	76
#35A Drum Cement Spray Unit [201]	24	24
#35A Drum Cement Spray Unit [201S]	65	65
#52 Drum Cement Spray Unit [202]	24	24
#52 Drum Cement Spray Unit [202S]	65	65
52-A Outside Tire Painter	236	236
52-A Inside Tire Painter	13	13
Rad. & Bias Tire Painter [304]	17	17
Rad. & Bias Tire Painter [304S]	46	46
Rad. & Bias Tire Painter #2 [305]	6	6
Rad. & Bias Tire Painter 2	203	203
Curing Press Rows 13 and 14	84	84
Curing Press Tows 11 and 12	157	157
1 unit - Rows 3,4,5,6,7 and 8	191	191
South Curing Rm. Row 9 and 10	118	118
Curing Pres Rows A & B	173	173
J Row - Heavy Duty Press	87	87
H.D. Inside G/T Painter	8	8
H.D. OUtside G/T Painter	91	91
No. 1 Boiler (Comb. Eng.)	3	3
No. 2 Boiler (Wickes)	3	3
No. 3 Boiler (B&W)	2	2
Total	2,729	2,729

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Penco Products, Inc.

SIC Code: 2542

Location: Upper Providence Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Wide Line -ES Paint	181	181
Narrow Line - ES Paint	182	182
Paint Baking Oven	545	545
Total	908	908

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Lee Tire & Rubber Co.

SIC Code: 3011

Location: Whitemarsh Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
#3 Banbury Mixer	21	0
#4 Banbury Mixer	11	0
#5 Banbury Mixer	19	0
#3,4 Batch-Off Mills	22	0
#1-11,12,13 Mills	9	0
#6 Calender	7	0
8-8 Undertread Cementer	25	0
10-10 Undertread Cementer	872	0
Bead Spray Booth	14	0
Precure Spray Booth #1	451	0
Precure Spray Booth #2	451	0
Precure Spray Booth #3	159	0
Truck Tire Pre-Cure Spray	220	0
51 Curing Presses Bldg. #45	257	0
25 Curing Presses Bldg. #2	126	0

16 Curing Presses, Bldg. #35	95	0
8 Curing Presses (Truck)	101	0
Passenger Tire Building	302	0
Truck Tire Building Area	64	0
Total	3,226	0

*Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Synthane - Taylor Corp.

SIC Code: 3079

Location: Upper Providence Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Coater #4	2	2
Coater #5	6	6
Coater #6	6	6
Saw Dept.	2	2
Small Lathe	1	1
Total	17	17

* Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Synthane - Taylor Corp., Valley Forge

SIC Code: 3079

Location: West Norriton Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Coater #2	4	4
Coater #3	1	1
Total	5	5

* Typical Summer Day for 1978

TABLE

Principal Emitting Operations at Point Sources of Reactive VOC Emissions for the Five County Southeastern Pennsylvania Region

Superior Tube Co.

SIC Code: 3841

Location: Lower Providence Township, Montgomery County

Principal Operations	1978 VOC Emissions (Kg/day)*	Estimated 1980 VOC Emissions (Kg/day)
Flush/Blowout Booth 1603	82	82
Flush/Blowout Booth	14	14
Flush/Blowout Booth	92	92
Flush/Blowout Booth	14	14
Spray Booth 1540	10	10
Total	212	212

* Typical Summer Day for 1978

Emissions by process for each source for Philadelphia County can be found in the annual NEDS submittal.

APPENDIX 1
DERIVATION OF ACTIVITY LEVELS AND
EMISSION FACTORS USED TO
DETERMINE VOLATILE ORGANIC COMPOUND EMISSIONS
BY SOURCE TYPE

Degreasing

1980 emissions were calculated by using a 3 lb./capita/year emission factor as recommended in reference 1. Population figures were taken from reference 2. Population figures for Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties were supplied by the Delaware Valley Regional Planning Commission (DVRPC) in reference 3. The emissions were assumed to be reactive and uniform throughout the year (reference 4).

1987 emissions were projected by population. 1987 population figures for Bucks, Chester, Delaware, Mongtomery, and Philadelphia Counties were supplied by the DVRPC. 1987 population figures for Lehigh and Northampton Counties were supplied by the Joint Planning Commission Lehigh-Northampton Counties (reference 5). The figures for Allegheny, Armstrong, Beaver, Butler, Washington, and Westmoreland Counties were calculated based on 1970 and 1980 census data. A 25% emission reduction was expected due to Departmental regulations.

Dry Cleaning

1980 emissions were calculated by using a 1.5 lb./capita/year emission factor as recommended in reference 1. The emission factor combined the 1.2 lb./capita/year emission for commercial plants and 0.3 lb./capita/year emission for self-service plants. Emissions were assumed to be reactive and uniform throughout the year (reference 4).

1987 emissions were projected by population. No emission reduction was expected as a result of Departmental regulations.

Architectural Coatings

1980 emissions were calculated using the national average of 4.6 lb./capita/year emission factor as recommended in reference 1. Emission were assumed to be reactive and uniform throughout the year (reference 4).

1987 emissions were projected by population. No emission reduction was expected as a result of Departmental regulations.

Auto Body Refinishing

1980 emissions were calculated by an emission/employee factor of 2.6 tons/employee/year as recommended by reference 1. The employment levels listed in reference 23 as SIC codes 7531 and 7535 were used to establish county activity levels. Emissions were assumed to be reactive and uniformly distributed throughout the year (reference 4).

1987 emisions were projected by employment. Employment levels were obtained from reference 20. No emission reduction due to Departmental regulations was expected.

Graphic Arts

1980 emissions were calculated using a 0.8 lb./capita/year emission factor as recommended in reference 1. Graphic Arts facilities included in the point source inventory were assumed to not be covered in this class. Emissions were assumed to be reactive and uniform throughout the year (reference 4).

1987 emissions were projected by population. No emission reduction due to Departmental regulations was expected.

Commercial/Consumer Solvent Use

1980 emissions were calculated using a 6.3 lb./capita/year emission factor as recommended in reference 1. Emissions were assumed to be reactive and uniform throughout the year (reference 4).

1987 emissions were projected by population. No emission reduction due to Departmental regulations was expected.

Cutback Asphalt

1980 cutback asphalt usage for state roads in gallons per county was supplied by the Pennsylvania Department of Transportation (reference 6). Emissions were calculated based on percentage solvent content (reference 7) and evaporation rates in reference 1. Average emission rates per mile of state road was assumed to be applicable to non-state roads. State and non-state road mileage was supplied by the Pennsylvania Department of Transportation (reference 8). Emission were assumed to occur during April through September (reference 4). All emissions were assumed to be reactive.

1987 emissions were projected by assuming non-complying cutback asphalt would be converted to emulsified asphalt as required by Departmental regulations. 1980 paving rates were assumed to be representative for 1987.

Structural Fires

1980 emissions were based on an estimated 6 fires per thousand people as recommended by reference 1. An emission factor of 107 lbs./structural fire was attained from reference 9. Reference 10 estimates the reactive portion of emissions as 58%. Therefore, a reactive emission factor of 62 lb./structural fire was used. Emission were assumed to uniform throughout the year (reference 4).

1987 emissions were projected based on population. No emission reduction was expected due to Departmental regulations.

Forest Fires

1980 fire statistics (acres burned/county) was supplied by the Division of Forest Fire Protection (reference 11). A fuel loading factor of 11 tons/acre was obtained from reference 12. Reference 12 suggests an average emission factor of 24 lbs./ton. Reference 10 quotes forest fire emissions as 80% reactive. An emission factor was calculated to be 19.2 lbs./ton. Emissions were assumed to be uniform throughout the year (reference 4).

1987 emissions were assumed to be constant. No emission reduction was expected due to Departmental regulations.

Gasoline Marketing

1980 gasoline sales were supplied by the Pennsylvania Department of Revenue (reference 13). Estimated vehicular travel (VMT) was supplied by the Pennsylvania Department of Transportation (reference 14) and DVRPC (reference 15). The total gallons sold was distributed to each county by VMT. Emission were calculated by emission factors from reference 12 of 9.4 lbs./1000 gallons for Stage I and 9.0 lbs./1000 gallons for Stage II. Emissions were assumed to be uniform throughout the year (reference 4).

1987 emissions were projected based on projected VMT and vehicle gasoline mileage. Gasoline mileage data was based on congressionally mandated values found in PL 94-163. VMT data for Lehigh and Northampton County was supplied by Pennsylvania Department of Transportation (reference 27). VMT data for Philadelphia and Pittsburgh were supplied by the designated agencies (references 15 and 26). Emissions for Stage I were assumed to be reduced 97% due to Departmental regulations. Estimated emission factors were taken from reference 12.

Highway Mobil Sources

1980 emissions, by county, were supplied by the Pennsylvania Department of Transportation (reference 14), Delaware Valley Regional Planning Commission (reference 15), and Southwestern Pennsylvania Regional Planning Commission (reference 26).

1987 emissions were supplied by the appropriate agency (references 27, 15, and 26). The inspection and maintenance program was assumed to be in effect in the three metropolitan areas of Allentown, Philadelphia, and Pittsburgh. Additional documentation on motor vehicle emissions is available from the appropriate agency.

Aircraft

1980 aircraft activity was supplied for all public airports by the Pennsylvania Department of Transportation (reference 16). Military aircraft operations were supplied by the Federal Aviation Administration (reference 17). A fleet mix was calculated for each airport. Average emission factors reflecting the fleet mix was developed from reference 12. All emissions were assumed to be reactive and uniformly distributed throughout the year (reference 4).

1987 emissions were projected using data supplied by the Pennsylvania Department of Transportation (reference 18). The fleet average emission factors were assumed to remain the same. No emission reduction was assumed as a result of Departmental regulations.

Railroad Locomotives

1980 emission factor of 94 lb./1000 gallons was taken from reference 12. Railroad fuel consumption was taken from reference 19. Emissions were allocated to the Counties by population. All emissions were assumed to be reactive. Emission were assumed to be uniformly distributed throughout the year (reference 4).

1987 emissions were projected by population. No emission reduction was expected due to Departmental regulations.

Vessels

1980 emissions were calculated as recommended in reference 1. All emissions were assumed to be reactive and uniformly distributed throughout the year (reference 4).

1987 emissions were projected by employment. Employment data was taken from reference 20. No emission reduction was expected as a result of,Departmental regulations.

Small Utility Engines

1980 emission factor of 448 lb./1000 gallons was calculated based on reference 12. Reference 12 recommends a national average fuel usage of 13 gallons per engine. Emissions were then calculated on a per engine basis. Emissions were assumed to be reactive. Emissions were assumed to occur during April through September (reference 4).

1987 emissions were projected by population. No emission reduction was expected due to Departmental regulations.

Agriculture

1980 emissions were based on the amount and type of fuel consumed by farm vehicles. The number of farm vehicles was obtained from reference 21. It was assumed that 60% of the tractors in the State were gasoline powered and the remaining 40% were diesel powered. The annual average fuel use of 427 gallons per tractor was provided by reference 22. Emission factors were obtained from Reference 12 for farm machinery. The emissions were assumed to be reactive and uniform in the period April through September (reference 4).

1987 emissions were based on agriculture employment from reference 20. No emission reduction was expected due to Departmental regulations.

Construction Equipment

1980 emission levels were calculated by using the number of employees for heavy construction from SIC 16 listed in the County Business Patterns (reference 23). Fuel consumption from reference 19 for off-highway fuel use was apportioned to the Counties by the number of heavy construction employees. The emission factors for the inventory were from reference 12. All emissions were assumed to be reactive and uniform throughout the year (reference 4).

1987 emission projections were based on heavy construction employment from reference 20. No emission reduction was expected due to Departmental regulations.

Point Sources

1980 point source data for Allegheny County was supplied by the Allegheny County Department of Health, Bureau of Air Pollution Control (reference 24). Point source emissions for Philadelphia County were supplied by the Philadelphia Department of Health, Air Management Services (reference 25).

Emissions for all other counties were calculated based on 1978 Pennsylvania Emissions Data System. The total hydrocarbon emissions for each emitting source in the State for those facilities greater than 15 tons per year were adjusted to reactive VOC based on reference 10. Emissions were adjusted to typical summer day by use of quarterly throughput data.

1987 emissions for Philadelphia and Allegheny Counties were supplied by the appropriate agency.

1987 activity levels for Armstrong, Beaver, Bucks, Butler, Chester, Delaware, Lehigh, Montgomery, Northampton, Washinton, and Westmoreland Counties was assumed to be constant. Expected plant shutdowns and the effect of Departmental regulations were used to adjust the emission levels. Industrial growth was estimated on a county wide basis by employment projection supplied by the appropriate agency.

APPENDIX 2
DERIVATION OF ACTIVITY LEVELS
AND EMISSION FACTORS USED TO DETERMINE
OXIDES OF NITROGEN EMISSIONS BY SOURCE TYPE

Railroads

1980 emission factor of 370 lbs./1000 gallons was taken from reference 12. Railroad fuel consumption was taken from reference 19. Emissions were allocated to the counties by population. Emissions were assumed to be uniform throughout the year (reference 4).

1987 emissions were projected by population. No emission reduction as a result of Departmental regulations was expected.

Aircraft

1980 aircraft activity was supplied for all public airports by the Pennsylvania Department of Transportation (reference 16). Military aircraft operations were supplied by the Federal Aviation Administration (reference 17). A fleet mix was calculated for each airport. Average emission factors reflecting the fleet mix was developed from reference 12. All emissions were assumed to be uniform throughout the year (reference 4).

1987 emissions were projected using the data supplied by the Pennsylvania Department of Transportation (reference 18). The fleet average emission factors were assumed to remain the same. No emission reduction as a result of Departmental regulations was assumed.

Vessels

1980 emissions were calculated as recommended in reference 1. All of the emissions were assumed to be uniformly distributed throughout the year (reference 4).

1987 emissions were projected by employment. Employment data was taken from reference 20. No emission reduction due to Departmental regulations was expected.

Small Utility Engines

1980 emission factor of 41.9 lbs./1000 gallons was calculated based on reference 12. Reference 12 recommends a national average fuel usage of 13 gallons per engine. Emissions were then calculated on a per engine basis. Emissions were assumed to occur during April through September (reference 4).

1987 emissions were projected by population. No emission reduction as a result of Departmental regulations was expected.

Agriculture

1980 emissions were based on the amount and type of fuel consumed by farm vechiles. The number of farm vehicles was obtained from reference 21. It was assumed that 60% of the tractors in the state were gasoline powered and the remaining 40% were desiel powered. The annual average fuel use of 427 gallons per tractor was provided by reference 22. Emission factors were obtained from reference 12 for farm machinery. Emissions were assumed to be uniform in the period April through September (reference 4).

1987 emissions were based on agriculture employment from reference 20. No emission reduction as a result of Departmental regulations was expected.

Construction Equipment

1980 emission levels were calculated by using the number of employees for heavy construction from SIC 16 listed in the County Business Patterns (reference 23). The fuel consumption from reference 19 for off-highway fuel use was apportioned to the counties by the number of heavy construction employees. The emissions factors for the inventory were from reference 12. All emissions were assumed to be uniform throughout the year (reference 4).

1987 emission projections were based on heavy construction employment from reference 20. No emission reduction due to Department regulations was expected.

Structure Fires

1980 emissions were based on an estimated six fires per thousand people as recommended by reference 1. An emission factor of 17 pounds per structure fire was obtained from reference 9. Emissions were assumed to be uniform throughout the year (reference 4).

1987 emissions were projected based on population. No emission reduction as a result of Departmental regulations was expected.

Forest Fires

1980 fire statistics (acres burned/county) was supplied by the Division of Forest Fire Protection (reference 11). A fuel loading factor of 11 tons per acre was obtained from reference 12. Reference 12 suggests an average emission factor of 4 pounds per ton. Emissions were assumed to be uniform throughout the year (reference 4).

1987 emissions were assumed to be constant.

Highway Mobile Sources

1980 emissions, by county, were supplied by the Pennsylvania Department of Transportation (reference 14), Delaware Valley Regional Planning Commission (reference 15), and Southwestern Pennsylvania Regional Planning Commission (reference 26).

1987 emissions were supplied by the appropriate agency (references 27, 15, and 26). The inspection and maintenance program was assumed to be in effect in the three metropolitan areas of the Allentown, Philadelphia, and Pittsburgh. Additional documentation on motor vehicle emissions is available from the appropriate agency.

Point Source

1980 point source data for Allegheny County was supplied by the Allegheny County Department of Health, Bureau of Air Pollution Control (reference 24). Point source emissions for Philadelphia County were supplied by the Philadelphia Department of Health, Air Management Services (reference 25).

Emissions for all other counties were based on 1978 Pennsylvania Emission Data System information. The total oxides of nitrogen emissions for each emitting source in the state for those facilities greater than 15 tons per year were adjusted to typical summer day by use of quarterly throughputs.

1987 emissions for Philadelphia and Allegheny Counties were supplied by the appropriate agency.

1987 activity levels for Armstrong, Beaver, Bucks, Butler, Chester, Delaware, Lehigh, Montgomery, Northampton, Washington, and Westmoreland Counties were assumed to be constant. Expected plant shutdowns and the effect of Departmental regulations were used to adjust the emission levels. Industrial growth was estimated on a countywide basis by employment projections supplied by the appropriate agency.

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Post Office Box 2063
Harrisburg, Pennsylvania 17120

May 14, 1982

Mr. Kent R. Miller
Acting Director
Regional Planning
Delaware Valley Regional Planning Commission
1819 J.F. Kennedy Boulevard
Philadelphia, PA 19103

Dear Mr. Miller:

Enclosed are the results of the variability study done by the Department on the Emperical Kinetic Modeling Approach (EKMA) model. This material is a follow-up to my April 26, 1982 letter to John Coscia.

I would like to point out that the work which DVRPC has done using EKMA has been performed well and is in accordance with the guidance supplied by the U.S. Environmental Protection Agency. The following discussion does not question your work with the model. Rather, it assesses the accuracy and precision of the model itself.

The Department performed a sensitivity analysis of the EKMA model. All input parameters to the EKMA model were varied over a range of values which reflects the accuracy of the measurement of these input parameters. For instance, the HC/NO_x ratio was varied from 6.0:1 to 10.5:1 because this is a conservative estimate of the range of values measured for the Philadelphia metropolitan area for days which show violations of the ozone standard. Each input parameter was varied individually. We did not study any synergistic effects. The Department has conducted this study in order to determine how the EKMA model varies when the model inputs are changed.

The Department used DVRPC's inputs for June 24, 1980. This was the day selected as the "control" data for the 1982 State Implementation Plan revision. The Department varied one input parameter at a time and analyzed the computer results for four potential $HC:NO_x$ ratios. The enclosed table contains the results of the variability study. The table lists the variables which were examined, the emission reduction requirements, and the maximum ozone value which is predicted for each variable.

Several generalities can be stated based on the study results. First, the predicted maximum ozone level when compared to the actual measured ozone exceedence is overestimated in most cases. Second, the surface ozone transport, maximum mixing height, and initial NO_2/NO_x ratios seemed to have little effect on the emission reduction requirements. Third, the initial propylene and aldehyde factions and concentrations of aloft ozone, surface and aloft hydrocarbon, and surface and aloft NO_x seem to have larger impacts on emission reduction requirements.

Specifically, several of the categories investigated appear to raise valid questions regarding the EKMA model. The EKMA model is chemically based on reactions of hydrocarbon compounds of propylene, aldehyde, and butane. These chemical compounds were selected to simulate smog chamber studies of automotive exhausts. Thus, this chemical make-up may be biased toward conditions not measured in ambient conditions. The EPA assumed that the VOC was 25% propylene. The EPA sampled hydrocarbon species at three sites in the Commonwealth in 1980 ("Sampling and Analysis of Hydrocarbon Species for Region III", August 1981). The nearest (to Philadelphia) sampling site was Kutztown. Data from this site would indicate that the propylene fraction is actually 1-8% of the reactive hydrocarbons. If this value was input into the EKMA model, the varability test results would indicate a control requirement less than 37.6% (HC:NO_x ratio of 8.2:1).

Pollutant transport is another area where EPA's methodology for running the EKMA model can be questioned. EPA guidance would indicate that transported levels of NO_x are very low when compared to urban levels and, therefore, should be ignored. DVRPC, in accordance with EPA guidance, included no transport of NO_x. The Department believes that the EPA guidance may be overly conservative. Aloft levels of oxides of nitrogen, if calculated using the same method as for ozone, would be recorded at levels of 0.02 ppm and greater. The variability study would indicate that the control requirement would be less than 38.0% (HC:NO_x ratio of 8.2:1). If surface NO_x measurements are input into the model, the control requirements would be less than 35.4% (HC:NO_x ratio of 8.2:1).

Finally, EPA guidance should be questioned concerning the HC:NO_x ratio selection. EPA guidance states that 6-9 a.m. ambient monitored levels of non-methane hydrocarbons and NO_x should be used to develop the HC:NO_x ratio. Ratios developed in this manner (for the days modeled) ranged from 2.7 to 13.9. This demonstrates the large variability in the ambient measurements which may be due to the large inaccuracies of the hydrocarbon monitors. Because of this, the median ratio may be a better indication of the day to day conditions. Thus, if the median HC:NO_x ratio of 6.9:1 was used, the emission reduction requirement would be 37.2%.

The Department believes that the results demonstrate that the EKMA model is highly variable and uncertain. For example, in the specific examples cited above, the emission reduction requirements ranged from less than 35% to 38%. Since the enforceable measures included in the plan are estimated to achieve an emission reduction in excess of 39%, the Department considers that the plan demonstrates attainment of the ozone standard by 1987 within the uncertainty inherent in the EKMA modeling methodology.

Thank you for your assistance in this matter. Should you have any questions, please feel free to contact me at telephone: (717) 787-4310.

Sincerely,

GARY L. TRIPLETT, Chief
Division of Air Resource Management
Bureau of Air Quality Control

Enclosure

PHILADELPHIA VARIABILITY TEST

Category	VALUE		Maximum Calculated O_3 (ppb)	% EMISSION REDUCTION			
	DVRPC	Variable		$HC:NO_x$ 6.0:1	$HC:NO_x$ 6.9:1	$HC:NO_x$ 8.2:1	$HC:NO_x$ 10.[illegible]1
Initial Propylene Fraction	0.25	0.15	180	24.6	29.2	37.6	45.[illegible]
		0.20	186	29.6	35.1	40.4	49.0
		0.30	193	37.0	42.0	47.7	55.2
		0.35	195	40.8	45.6	50.0	57.[illegible]
Initial NO_2/NO_x Ratio	0.25	0.15	190	33.3	39.1	43.2	51.5
		0.20	190	32.6	38.4	43.2	53.1
		0.30	190	32.6	40.0	46.1	52.6
		0.35	190	33.7	38.8	44.3	52.6
Initial Aldehyde Fraction	0.05	0.02	188	29.8	35.2	41.3	50.5
		0.10	193	37.9	43.2	48.8	56.7
Maximum Mixing Height	1235m	1100m	203	32.5	39.0	44.3	51.2
		1500	171	33.3	39.8	45.8	52.9
		1700	159	33.1	38.5	45.5	54.1
Pollutant Transport							
Surface O_3	0.009ppm	0.000ppm	190	33.3	39.1	43.8	51.5
		0.020	190	32.6	38.1	45.5	52.6
Aloft O_3	0.050	0.030	183	29.5	35.4	41.1	49.0
		0.080/0.069	201	36.8	42.1	48.1	55.2
Surface HC	0.0	0.6	205	59.7	63.6	68.5	74.4
Aloft HC	0.040/0.024	0.021	188	34.4	40.0	44.0	54.0
		0.099	195	41.6	48.0	53.0	61.7
		0.040	190	35.6	40.0	46.1	55.6
Surface NO_x	0.0	0.1	202	27.1	30.7	35.4	42.0
Aloft NO_x	0.00	0.02	203	28.4	32.9	38.0	46.9
Transport only Aloft O_3		0.05	186	31.9	36.3	43.0	49.5
Standard Run (DVRPC)			185	32.6	37.2	43.8	53.5
		Actual O_3	171				

T8.12

1982 STATE IMPLEMENTATION PLAN

PHILADELPHIA AIR QUALITY CONTROL REGION

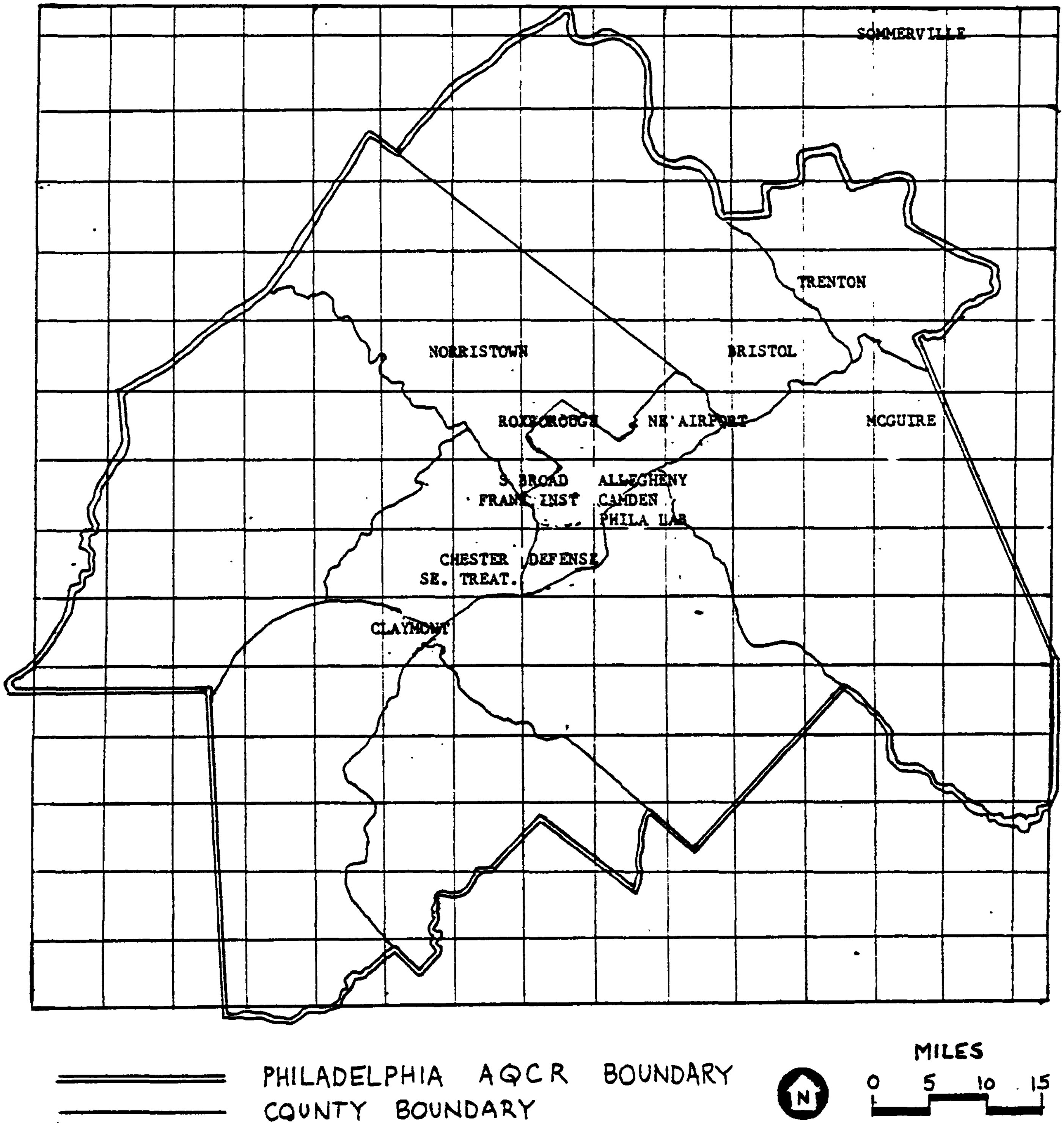
EKMA ANALYSIS SUMMARY

SITE DAY SELECTION

DATA - 1979-1981 MAXIMUM HOURLY OZONE READINGS PHILADELPHIA AQCR MONITORING SITES

SOURCE - PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
PHILADELPHIA AIR MANAGEMENT SERVICES

PROCESS - IDENTIFY 5 HIGHEST HOURLY OZONE RECORDINGS ABOVE 15 PPM STANDARD


SOMMERVILLE
TRENTON
NORRISTOWN
BRISTOL
ROXBOROUGH
NE AIRPORT
MCGUIRE
S BROAD
ALLEGHENY
FRANK INST
CAMDEN
PHILA LAB
CHESTER
DEFENSE
SE. TREAT.
CLAYMONT
PHILADELPHIA AQCR BOUNDARY
COUNTY BOUNDARY
N
MILES
0 5 10 15

MAXIMUM OZONE VIOLATIONS 1979-1981

SITE	DATE	MAX O3 PPM
BRISTOL	8/26/80	.201
BRISTOL	6/05/79	.193
BRISTOL	5/15/80	.183
BRISTOL	8/07/80	.176
BRISTOL	8/27/80	.176
CAMDEN	7/18/81	.180
CAMDEN	7/21/80	.174
CAMDEN	5/15/81	.169
CAMDEN	8/26/80	.166
CAMDEN	8/07/80	.164
CAPE MAY	6/30/81	.200
CAPE MAY	7/12/81	.150
CHESTER	8/25/80	.194
CHESTER	7/13/79	.183
CHESTER	7/16/80	.172
CHESTER	6/07/79	.170
CHESTER	7/04/80	.169
CLAYMONT	7/16/80	.170
CLAYMONT	8/10/79	.170
CLAYMONT	7/19/79	.160
CLAYMONT	7/21/80	.150
MCGUIRE	7/21/80	.228
MCGUIRE	7/16/80	.218
MCGUIRE	7/31/80	.204
MCGUIRE	8/01/80	.193
MCGUIRE	8/02/80	.173
N/E AIRP	8/05/80	.180
N/E AIRP	8/07/80	.180
N/E AIRP	5/15/81	.180
N/E AIRP	6/29/80	.170
N/E AIRP	7/13/79	.160
NORRISTO	8/01/81	.221
NORRISTO	6/19/80	.197
NORRISTO	7/13/79	.183
NORRISTO	8/14/80	.178
NORRISTO	5/28/80	.176

PHILADELPHIA EKMA ANALYSIS 1982 SIP
MAXIMUM OZONE VIOLATIONS 1979-1981

SITE	DATE	MAX O3 PPM
ROXBOROU	7/13/79	.200
ROXBOROU	7/19/79	.170
ROXBOROU	7/20/79	.170
ROXBOROU	8/28/79	.160
ROXBOROU	6/24/80	.160
S/E TREA	7/12/79	.170
SOMMERVI	7/09/79	.163
TRENTON	6/15/81	.206
TRENTON	7/21/80	.194
TRENTON	8/04/80	.189
TRENTON	6/24/80	.171
TRENTON	5/23/80	.164

TRAJECTORY IDENTIFICATION

DATA - SURFACE WIND SPEEDS AND DIRECTIONS PHILADELPHIA AMS ALLEGHENY MONITORING STATION* FOR SELECTED DATES.

SOURCE - PHILADELPHIA AIR MANAGEMENT SERVICES

PROCESS - CALCULATE AVERAGE WIND SPEED AND PREVAILING DIRECTION

- ELIMINATE SITE-DAYS NOT DOWNWIND PHILADELPHIA CBD

- IDENTIFY UPWIND MONITORING SITE FOR ALOFT O_3

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* NE AIRPORT SUBSTITUTED FOR MISSING DATA

SITE-DAYS ELIMINATED

SITE	DATE	MAX O3 PPM	WIND DIREC 1-16	WIND SPEED MPH
BRISTOL	8/26/80	.201	VR	3
BRISTOL	8/07/80	.176	VR	3
CAMDEN	7/18/81	.180	9	3
CAMDEN	7/21/80	.174	11	4
CAMDEN	6/16/81	.169	10	4
CHESTER	7/16/80	.172	10	4
CHESTER	7/04/80	.169	13	
CLAYMONT	7/16/80	.170	10	4
CLAYMONT	8/10/79	.170	10	7
CLAYMONT	7/19/79	.160	VR	8
CLAYMONT	7/21/80	.150	11	4
MCGUIRE	7/31/80	.204	VR	3
MCGUIRE	8/01/80	.193	VR	4
NORRISTO	6/19/80	.197	9	3
NORRISTO	8/14/80	.178	10	4
ROXBOROU	8/28/79	.160	8	9
S/E TREA	7/12/79	.170	14	8

SITE-DAYS SELECTED FOR ANALYSIS

SITE	DATE	MAX O3 PPM	WIND DIREC 1-16	WIND SPEED MPH	UPWIND O3 SITE
BRISTOL	6/05/79	.193	10	4	CLAYMONT
CHESTER	6/07/79	.170	4	3	VAN HISLVL
SOMMERVI	7/09/79	.163	9	6	DOWNINGTOW
ROXBOROU	7/13/79	.200	VR	7	DOWNINGTOW
CHESTER	7/13/79	.183	VR	7	DOWNINGTOW
NORRISTO	7/13/79	.183	VR	7	DOWNINGTOW
N/E AIRP	7/13/79	.160	VR	7	DOWNINGTON
ROXBOROU	7/19/79	.170	VR	8	DOWNINGTOW
ROXBOROU	7/20/79	.170	VR	5	SOMMERVILL
BRISTOL	5/15/80	.183	11	3	CLAYMONT
TRENTON	6/23/80	.164	10	3	CLAYMONT
TRENTON	6/24/80	.171	10	3	CLAYMONT
ROXBOROU	6/24/80	.160	10	3	CLAYMONT
NORRISTO	6/28/80	.176	VR	4	CLAYMONT
N/E AIRP	6/29/80	.170	10	3	CLAYMONT
MCGUIRE	7/16/80	.218	10	4	CLAYMONT
MCGUIRE	7/21/80	.228	11	4	CLAYMONT
TRENTON	7/21/80	.194	11	4	CLAYMONT
MCGUIRE	8/02/80	.173	10	5	CLAYMONT
TRENTON	8/04/80	.189	10	3	CLAYMONT
N/E AIRP	8/05/80	.180	9	4	CLAYMONT
N/E AIRP	8/07/80	.180	VR	3	NORRISTOWN
CAMDEN	8/07/80	.164	VR	3	NORRISTOWN
CHESTER	8/25/80	.194	VR	3	CLAYMONT
CAMDEN	8/26/80	.166	VR	3	CLAYMONT

SITE-DAYS SELECTED FOR ANALYSIS

SITE	DATE	MAX O3 PPM	WIND DIREC 1-16	WIND SPEED MPH	UPWIND O3 SITE
BRISTOL	8/27/80	.176	13	3	CLAYMONT
TRENTON	6/15/81	.206	10	3	CLAYMONT
N/E AIRP	6/15/81	.180	10	3	CLAYMONT
CAPF MAY	6/30/81	.200	4	7	SOMMERVILE
CAPE MAY	7/12/81	.150	14	0	NORRISTIWN
NORRISTO	8/01/81	.221	VR	A	CLAYMONT

ALOFT OZONE

DATA	- SURFACE OZONE READING HOUR AFTER INVERSION RISE AT IDENTIFIED UPWIND MONITOR
SOURCE	- STATE MONITORING DATA OR PHILADELPHIA OXIDANT DATA ENHANCEMENT STUDY 1979
PROCESS	- 1979 EPA ACOUSTIC RADAR USED TO DELINEATE INVERSION RISE
	- 1980/1981 ASSUME 11 A.M. INVERSION BREAK-UP BASED UPON 1979 DATA

ALOFT NON-METHANE HYDROCARBONS & OXIDES OF NITROGEN

"Philadelphia Oxidant Data Enhancement Study"

DATE	NMHC	NOX	O_3 PPM	Surface O_3 * PPM
7/5/79	0.029	---	---	---
8/4/79	---	0.000	0.054	0.058
8/5/79	0.058	0.011	0.044	0.058
8/6/79	---	0.002	0.023	0.061
8/7/79	0.037	0.000	0.026	0.031
8/10/79	0.099	0.000	0.051	0.058
8/16/79	0.021	0.000	---	---
Mean	0.045	0.002	0.040	0.053
Median	0.037	0.000	0.044	0.058
Design Value	0.040	0.000	--- (Surface Monitors)	

* Downingtown Surface Monitor Readings 10 A.M.

ALOFT NMHC/NOX

DATA - EPA HC/NOX MONITOR READINGS
1979 AIRCRAFT FLIGHT

SOURCE - PHILADELPHIA OXIDANT DATA ENHANCEMENT
STUDY

PROCESS - CALCULATE MEDIAN OBSERVED READINGS
FROM AIRCRAFT DATA

SURFACE OZONE

DATA - 6-9 A.M. OZONE CONCENTRATIONS AT PHILADELPHIA CORE MONITORING LOCATIONS

SOURCE - PHILADELPHIA AIR MANAGEMENT SERVICES

PROCESS - CALCULATE AVERAGE OZONE CONCENTRATIONS FRANKLIN INSTITUTE, SOUTH BROAD, PHILADELPHIA LAB

MIXING HEIGHTS

DATA - RADIOSONDE DATA NEW YORK CITY AND DULLES AIRPORT 1979/1980

SOURCE - NATIONAL CLIMATIC CENTER

PROCESS - CALCULATE 8 A.M. AND MAXIMUM MIXING HEIGHTS BY SUPERIMPOSING DRY ADIABATIC LAPSE ON AVERAGE RADIOSONDE DATA FOR TWO STATIONS

- IF AFTERNOON MIXING   ONE-THIRD CLIMATOLOGICAL MIXING VALUE USE MORNING SOUNDING TO ADJUST FOR SURFACE-BASED STABLE LAYER

- MEDIAN 1979-1980 MIXING HEIGHTS APPLIED FOR 198L

NMHC/NOX RATIOS

DATA - 6-9 A.M. NMHC & NOX READINGS PHILADELPHIA CORE MONITORING STATIONS

SOURCE - PHILADELPHIA AIR MANAGEMENT SERVICES

PROCESS - CALCULATE 6-9 A.M. RATIO AT FRANKLIN INSTITUTE, SOUTH BROAD, AND PHILADELPHIA LAB.

- DETERMINE AVERAGE RATIO
- IF EACH SITE WITHIN 30% OF AVERAGE APPLY DAY SPECIFIC AVERAGE
- IF NOT: APPLY MEDIAN VALUE

MEDIAN NMHC/NOX RATIO

SITE	RANK	MAX 03	DATE	AVG RATI ******	
BRISTOL	5	176	8/27/80	2.7	
N/E AIRPORT	3	180	6/15/81	3.7	
CAMDEN	5	164	8/07/80	3.8	
ROXBOROUGH	3	170	7/20/79	4.6	
MCGUIRE	5	173	8/02/80	4.6	
CAMDEN	4	166	8/26/80	4.7	
TRENTON	5	164	6/23/80	5.2	
NORRISTOWN	5	176	6/28/80	5.3	
CHESTER	4	170	6/07/79	5.5	
CHESTER	1	194	8/25/80	5.8	
TRENTON	3	189	8/04/80	6.1	
N/E AIRPORT	4	170	6/29/80	6.9	
N/E AIRPORT	1	180	8/05/80	6.9	** MEDIAN **
N/E AIRPORT	5	160	7/13/79	7.2	
MCGUIRE	2	218	7/16/80	7.7	
NORRISTOWN	1	221	8/01/81	7.8	
ROXBOROUGH	2	170	7/19/79	7.9	
ROXBOROUGH	5	160	6/24/80	8.2	
BRISTOL	2	193	6/05/79	9.5	
CAPE MAY	2	150	7/12/81	10.8	
TRENTON	2	194	7/21/80	11.5	
SUMMERVILE	1	163	7/09/79	12.0	
CAPE MAY	1	200	6/30/81	12.8	
BRISTOL	3	183	6/15/80	13.9	

EMISSION DENSITIES

DATA - 6-9 A.M. NMHC AND NOX READINGS
PHILADELPHIA CORE MONITORING STATIONS

1982 SIP EMISSION INVENTORIES

- WIND TRAJECTORIES PHILADELPHIA CBD TO MAXIMUM OZONE MONITOR
- 8 A.M. MIXING DEPTH

SOURCE - PENN DER/NJDEP AREA/STATIONARY INVENTORIES

- DVRPC MOBILE SOURCE EMISSION INVENTORY

PROCESS - CALCULATE INITIAL DENSITY EACH POLLUTANT BASED UPON MONITORING DATA AND 8 A.M. MIXING DEPTH
- CALCULATE RATIO OF GRIDDED EMISSIONS VERSUS INITIAL DENSITIES BASED UPON TRAJECTORY LOCATION

SCREENING ANALYSIS

DATA - DAY SPECIFIC EMISSION REDUCTION TARGETS

PROCESS - APPLY EKMA PROCEDURE TO EXISTING CONDITIONS TO EVALUATE MODEL PERFORMANCE

- CALCULATE SITE-DAY SPECIFIC REDUCTIONS ASSUMING CONSTANT PRECURSOR AND OZONE TRANSPORT

- SELECT HIGHEST THREE REDUCTION TARGETS FOR FURTHER ANALYSES

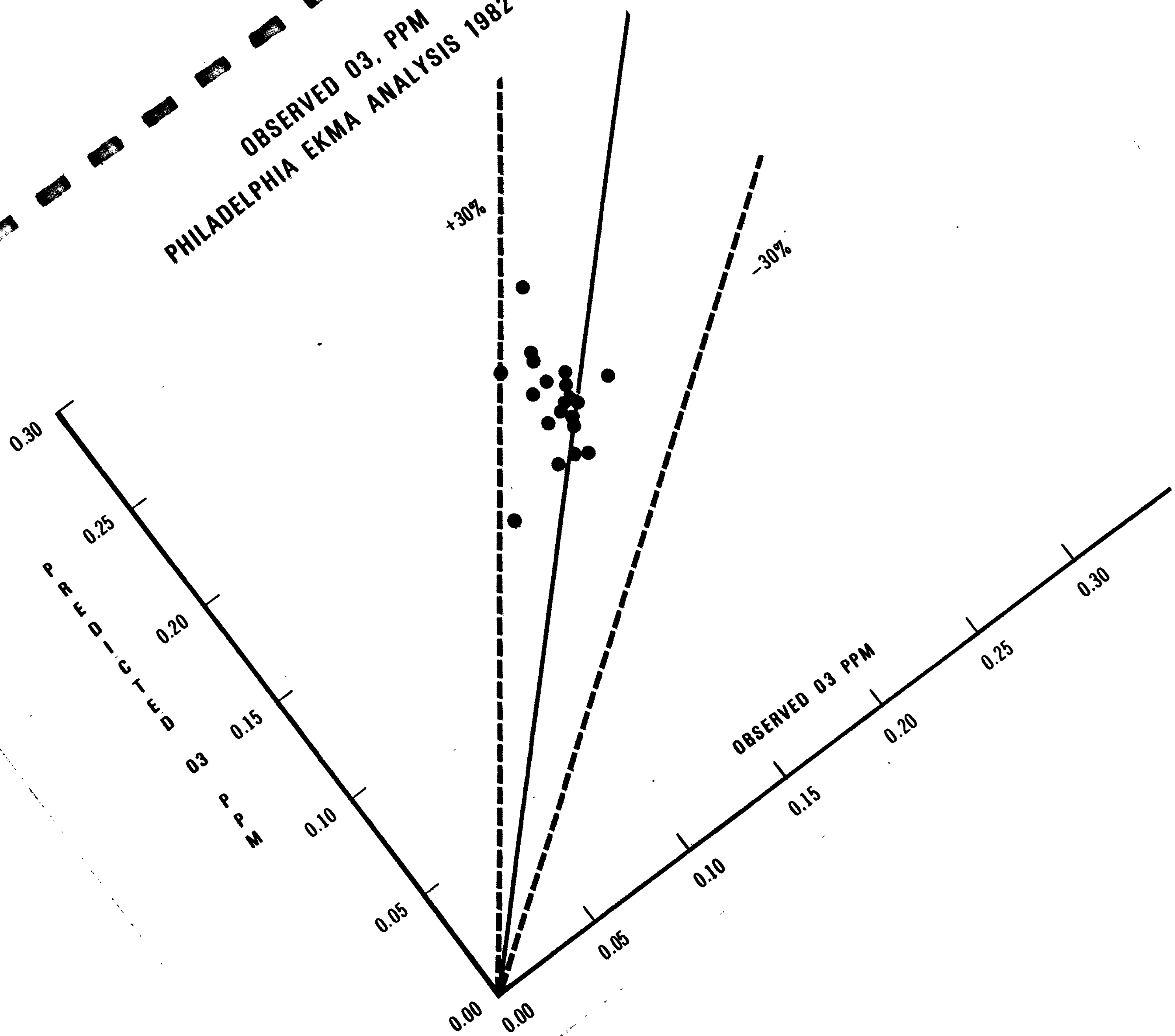
RESULT AND INPUT DATA SUMMARY

NOTE: * SIGNIFIES DEFAULT VALUES

SITE	DATE	MAX O3 PPM	CAL O3 PPM	HC RED TAR	SURFACE O3 PPM	ALFT O3 PPM	HC PPM	NOX PPM	HC-NOX RATIO	MIN MIX MET	MAX MIX MET	MAX H
BRISTOL	8/27/80	.176	.170	.49	0.002	.060	* .60	.14	*6.9	250	1132	1400
BRISTOL	6/05/79	.193	.227	.39	0.001	*.042	1.64	.17	*6.9	250	1230	1600
BRISTOL	6/15/80	.183	.170	.20	0.027	.040	* .60	.04	*6.9	250	1232	1500
CAMDEN	8/07/80	.164	.000	.43	0.006	.059	.31	.08	*6.9	311	1025	1500
CAMDEN	8/26/80	.166	.155	.37	0.001	.020	* .60	.11	*6.9	250	1232	1500
CAPE MAY	6/30/81	.200	.145	.45	0.027	*.042	1.18	.09	*6.9	250	1232	1500
CAPE MAY	7/12/81	.150	.124	.40	0.012	.052	.67	.06	10.8	250	1232	1500
CHESTER	7/13/79	.183	.000	.54	0.004	.105	1.10	.17	*6.9	250	1232	1500
CHESTER	6/07/79	.170	.198	.38	0.006	.043	.51	.10	*6.9	250	909	1500
CHESTER	8/25/80	.194	.171	.35	0.000	*.042	.78	.13	5.8	250	1232	1500
MCGUIRE	7/16/80	.218	.154	.47	0.005	.040	.63	.09	7.7	250	1253	1600
MCGUIRE	8/02/80	.173	.186	.43	0.025	.050	.16	.03	*6.9	250	640	1400
MCGUIRE	7/21/80	.228	.176	.42	0.009	.090	.58	.06	*6.9	250	1232	1500
N/E AIRP	8/07/80	.180	.163	.52	0.006	.059	.31	.08	*6.9	311	1025	1500
N/E AIRP	7/13/79	.160	.000	.50	0.004	.105	1.10	.17	*6.9	250	1232	1500
N/E AIRP	6/15/81	.180	.000	.48	0.000	.030	* .60	.13	*6.9	250	1232	1500
N/E AIRP	8/05/80	.180	.177	.39	0.006	.040	.54	.08	6.9	250	1150	1500
N/E AIRP	6/29/80	.170	.166	.29	0.009	.030	.36	.05	*6.9	300	1232	1500
NORRISTO	8/01/81	.221	.205	.54	0.002	*.042	1.41	.19	7.8	250	1232	1500
NORRISTO	7/13/79	.183	.000	.54	0.004	.105	1.10	.17	*6.9	250	1232	1500
NORRISTO	6/28/80	.176	.128	.38	0.014	*.042	.22	.03	*6.9	250	1232	1500
ROXBOROU	7/13/79	.200	.213	.59	0.004	.105	1.10	.17	*6.9	250	1232	1500
ROXBOROU	7/20/79	.170	.168	.53	0.002	.070	.45	.11	*6.9	250	1449	1400
ROXBOROU	6/24/80	.160	.000	.39	0.009	.050	1.11	.12	8.2	250	1235	1600
ROXBOROU	7/19/79	.170	.175	.37	0.003	.032	.37	.06	*6.9	250	1132	1400
SOMMERVI	7/09/79	.163	.202	.58	0.005	.083	1.62	.12	12.0	239	1434	1500
TRENTON	6/23/80	.164	.192	.58	0.004	.040	.92	.16	*6.9	388	1533	1700
TRENTON	6/15/81	.206	.151	.55	0.000	.030	* .60	.13	*6.9	250	1232	1500
TRENTON	8/04/80	.189	.139	.45	0.003	.040	.44	.07	*6.9	250	1232	1500
TRENTON	6/24/80	.171	.185	.44	0.009	.050	1.11	.12	8.2	250	1235	1600
TRENTON	7/21/80	.194	.000	.42	0.009	.090	.58	.06	*6.9	250	1232	1500

PHILADELPHIA EKMA ANALYSIS 1982 SIP

OBSERVED O3, PPM



DESIGN REDUCTION

DATA - DAY SPECIFIC EMISSION REDUCTION TARGETS

PROCESS - APPLY EKMA PROCEDURE ASSUMING APPROPRIATE FUTURE REDUCTION IN NMHC AND OZONE TRANSPORT

- SELECT HIGHEST REDUCTION TARGET FOR STATE IMPLEMENTATION PLAN

```
OZIPP TO CALCULATE FINAL EKMA REDUCTION TARGETS TRENTON

PHOTOLYTIC RATE CONSTANTS CALCULATED FOR

              PHILADELPHIA  CBD

LATITUDE      39.933
LONGITUDE      79.150
TIME ZONE     5.0
DATE          6     24    1980
TIME          800   TO    1800      LOCAL DAYLIGHT TIME
SOLAR NOON    1319

DILUTION DETERMINED FROM THE FOLLOWING
MIXING HEIGHTS          INITIAL   250.      FINAL       1235.
TIMING                  START     800.      STOP        1600.

MIXING HEIGHTS (AT THE BEGINNING OF EACH HOUR)
TIME        800    900   1000   1100   1200   1300   1400   1500   1600
HEIGHT    250.0  406.7  609.6  804.1  949.9 1052.8 1128.1 1185.4 1235.0

INITIAL PROPYLENE FRACTION      0.250       NO2/NOX   0.250
INITIAL ALDEHYDE FRACTION       0.050

TRANSPORTED CONCENTRATIONS
SURFACE LAYER           OZONE    0.009      HYDROCARBON  0.0       NOX  0.0   PPM
ALOFT                   OZONE    0.050      HYDROCARBON  0.040     NOX  0.0   PPM

CONTINUOUS EMISSIONS (EXPRESSED AS THE FRACTION OF INITIAL
NON-BACKGROUND HYDROCARBON CONCENTRATION EMITTED PER HOUR)
HOUR         1     2     3     4     5     6     7     8
FRACTION 0.170 0.170 0.170 0.100 0.020 0.020 0.020 0.020
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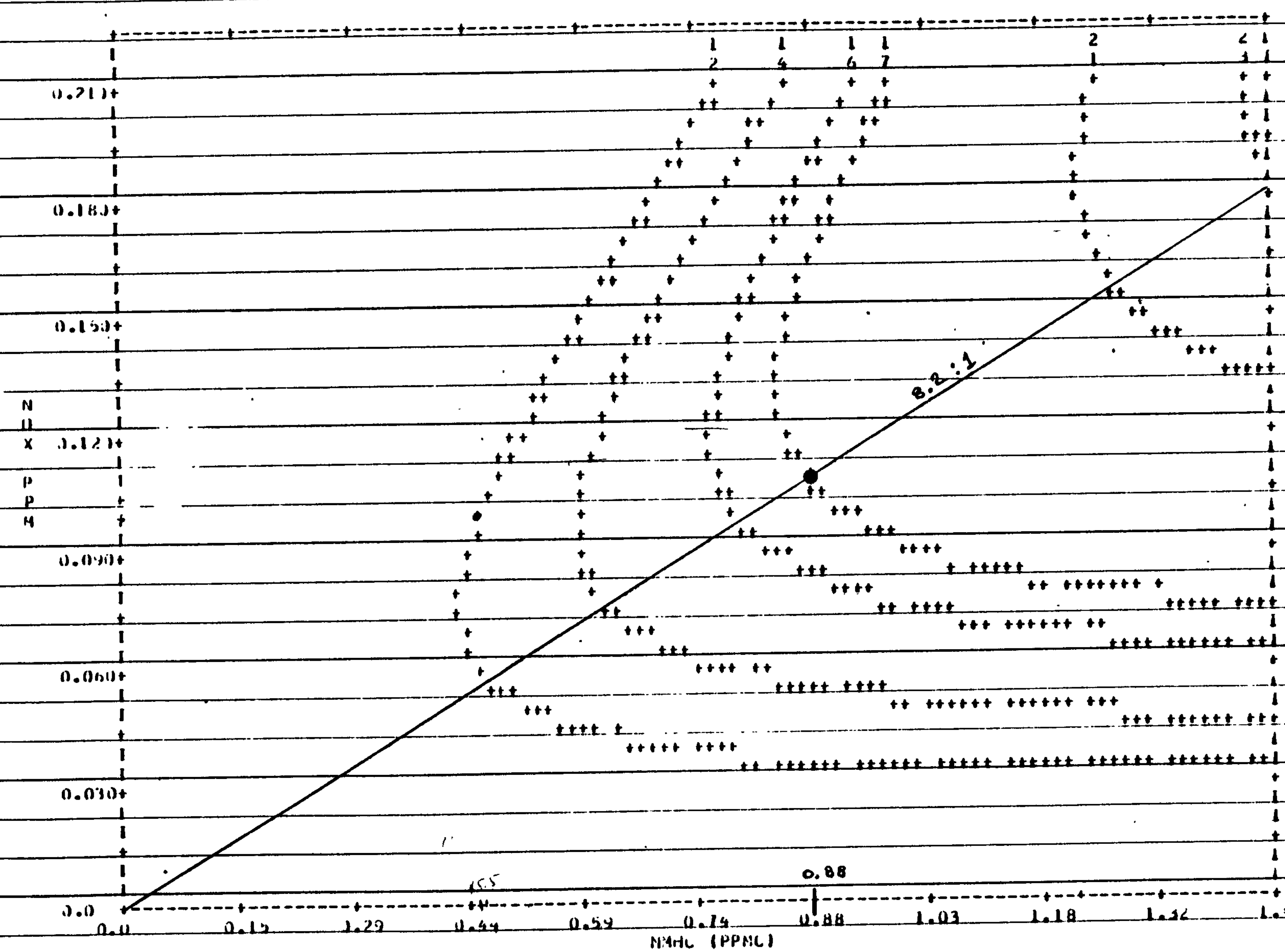


OZIPP TO CALCULATE FINAL EKMA REDUCTION TARGETS TRENTON

THE OZONE LINES ARE 0.12000 0.14000 0.16000 0.17000 0.21000 0.23000

OZIPP TO CALCULATE FINAL EKMA REDUCTION TARGETS TRENTON

PHOTOLYTIC RATE CONSTANTS CALCULATED FOR

PHILADELPHIA CBD

LATITUDE 39.933

LONGITUDE 75.150

TIME ZONE 5.0

DATE 6 24 1980

TIME 800 TO 1800 LOCAL DAYLIGHT TIME

SOLAR NOON 1319

DILUTION DETERMINED FROM THE FOLLOWING

MIXING HEIGHTS INITIAL 250. FINAL 1235.

TIMING START 800. STOP 1600.

MIXING HEIGHTS (AT THE BEGINNING OF EACH HOUR)

TIME	800	900	1000	1100	1200	1300	1400	1500	1600
HEIGHT	250.0	406.7	609.6	804.1	949.9	1052.8	1128.1	1186.4	1235.0

INITIAL PROPYLENE FRACTION 0.250 NO2/NOX 0.250

INITIAL ALDEHYDE FRACTION 0.050

TRANSPORTED CONCENTRATIONS

SURFACE LAYER OZONE 0.009 HYDROCARBON 0.0 NOX 0.0 PPM

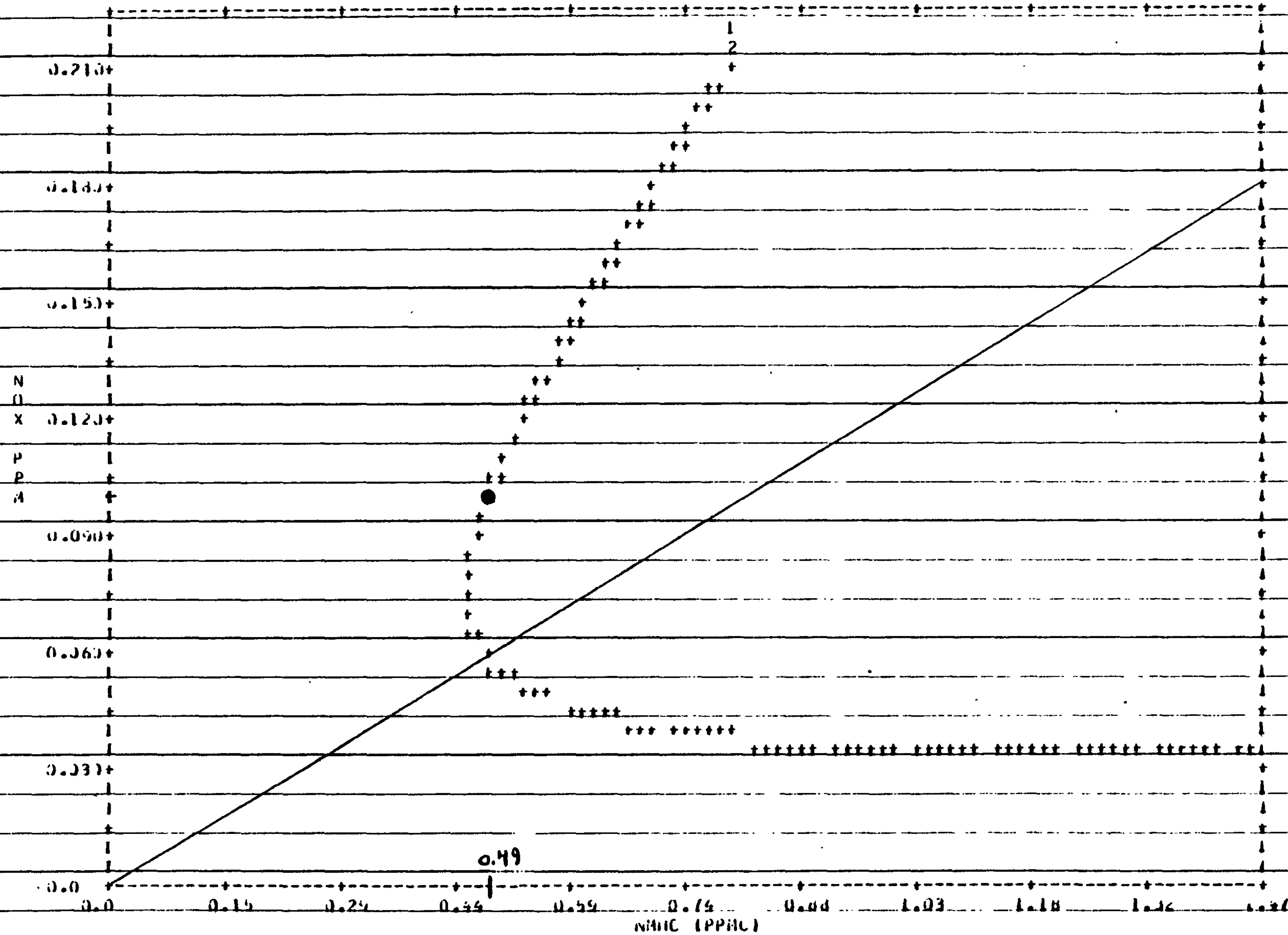
ALOFT OZONE 0.050 HYDROCARBON 0.024 NOX 0.0 PPM

CONTINUOUS EMISSIONS (EXPRESSED AS THE FRACTION OF INITIAL,

NON-BACKGROUND HYDROCARBON CONCENTRATION EMITTED PER HOUR)

HOUR	1	2	3	4	5	6	7	8
HC FRACTION	0.170	0.170	0.170	0.100	0.020	0.020	0.020	0.020

NO_x 35 7



OZIPP TO CALCULATE FINAL EKMA REDUCTION TARGETS TRENTON

THE OZONE LINES ARE 0.12000

THE PHILADELPHIA CENTER CITY CARBON MONOXIDE STUDY

Prepared by:
Air Management Services
The Philadelphia Department
of Public Health

June 1982

CONTENTS

INTRODUCTION

The Philadelphia, Center City, Carbon Monoxide Study was sponsored by the Delaware Valley Regional Planning Commission and was conducted by Air Management Services, an agency of the Philadelphia Department of Public Health. Funds for the Project were provided by the Urban Mass Transit Administration. The purpose of the study was to provide a basis for determining whether the National Ambient Air Quality Standard for Carbon Monoxide (CO) will be achieved in Philadelphia's central business district (CBD) by 1983 or by 1987. This report summarizes the technical aspects of the study.

A mathematical model was developed which could predict CO concentration at any desired location. A new model was developed because a greater accuracy than existing models provide was desired. The results of the study will assist in determining whether new transportation control measures are needed to achieve air quality goals.

The following individuals assisted in the development and review of the project and their effort is appreciated.

Air Management Services (AMS)

John Brotherston - Study Coordinator

George McCloskey - Meteorologist - development of computer model.

Thomas Weir - Staff Engineer - editing and technical assistance.

Roger Levy - Staff Engineer - Computer graphics

Fred Hauptman - Staff Engineer - Directed the placement and maintenance of the CO monitoring stations used in the study.

Thomas Heary - Student - assembled and translated traffic information into computer format.

Vincent DiCioccio - Student - assisted in area source and vehicle emission development

Philadelphia Department of Streets

Charles Denny - Traffic Engineer - provided the special traffic and street information required for the study.

Environmental Protection Agency (EPA) Region III

Chuck Miesse - Technical liaison.

Delaware Valley Regional Planning Commission (DVRPC)

Ron Fijalkowski - Technical liaison - provided Mobile II emission factors.

Robert Gallagher - Study Coordinator at DVRPC.

PROCEDURE

The model developed for this study predicts CO concentrations by considering each street as a series of emission cells sequentially downwind in a gaussian diffusion process. The program has similarities to the Highway 2 and Caline 3 models. Emission data is accessed from a file containing information on 539 street segments and 15 area sources. A street segment is a line source bound by intersections (nodes).

The inventory gives street segment information for any individual node bounded by the node to the west of the node to the north. Street width, travel time, 8 hour average traffic count, street height and coordinates are given for the west and north street segments. In the computer program adjoining street segments are considered as the wind is simulated to pass over the modeling area. Each segment is broken into cells which are 10 meters downwind in depth. Cell width depends on the size of the street exposed perpindicular to the wind and is as a minimum the street width. Area sources are considered as large, wide streets divided into 5 cells.

In the computer map output, one of 18 numbers and symbols was printed to indicate the CO concentration for each 8 by 10 meter parcel in the CBD area. A display for a fixed wind direction represented 47,500 parcels and required approximately 85 hours of CPU time on a Hewlett Packard 1000 Scientific Computer.

Because of the extensive amount of computer time needed, only one wind direction was considered for each display. During the development of the model sensitivity studies had shown, as was expected, that the highest CO levels occurred when the wind was nearly parallel to the streets. This is so since the receptors are offset from the traffic lanes and the highest CO concentrations occur along the centerline of the wind.

To adequately account for the concentrated traffic on Interstate 95, the Schuylkill Expressway, and Broad Street, these roads were extended into what would normally be considered a background area source. As an example Broad Street was extended north from Callowhill Street to Ogontz Avenue, with an equivalent VMT subtracted from the North Central Philadelphia area source. Broad Street was extended South to Pattison Avenue from Bainbridge Street with an equivalent VMT subtracted from the South Philadelphia areas source. North Broad Street generates a higher VMT than travel on Broad Street South of City Hall. Therefore, the extended Broad Street with a North wind yields a greater CO impact than a south wind on the CBD display map. A similar analysis was made to determine the west wind as having the higher contribution to CO levels in the East West orientation.

The EPA worst case condition essentially represents a one hour meteorological condition. A 1-mps wind velocity indicates light wind conditions. Wind directions will be highly variable especially with light velocities in a CBD area. The chosen value of "D" stability* indicates that the wind direction has a 10° standard deviation for 1 hour. We must consider the wind direction for the other 7 hours. To consider the wind direction to be constant

*D Stability - represents neutral air turbulence and is applicable to heavy overcast weather day or night.

for 8 hours would be unrealistic. To adjust a one hour average to an 8 hour average a meteorological persistence factor of 0.7 is frequently used. In reviewing meteorological data for Philadelphia, however, a wind direction persistence within 90° for an 8 hour period was felt to be realistic. Two major runs were made, therefore, one with the wind parallel to Vine Street (281.35°) and one parallel to Broad Street (11.35°), a hypothetical worst case condition.

The CO maps from the computer runs were then placed on a light table at right angles to each other. This procedure is equivalent to an 8-hour average of CO with 4 hours of wind direction at 11.35° and 4 hours of wind direction at 281.35°. Areas with predicted values of 9 ppm or more represented potential "hot spot" areas. The larger the area, the more likely the exceedance.

In addition to the display map, optional outputs include predicted concentrations of CO for specific sites and predicted sidewalk concentrations at 10 meter intervals along a chosen street.

DISCUSSION AND RESULTS

The boundaries of the eight locations where violations are predicted based on north wind and west wind computer runs in 1983 are presented in Table 1. Figure 1 shows the boundaries of the Broad and Vine hotspot. The boundaries result from the previously described overlay of the N-S plots on the W-E plots. Since the displays represent 1 hour CO concentrations it was immediately clear that the 1 hour Air Quality Standard would not be exceeded in 1983.

To further evaluate CO exceedances an analysis was made of the dependence of CO concentration on wind direction at the major hot-spot (Broad & Vine) for 1983. Table 2 indicates average 1 hour carbon monoxide concentrations produced on the sidewalk center-line with various wind angled to the roadway. The North sidewalk of Vine Street is exposed to the highest concentrations. Figure 2 graphically shows how CO levels on Vine and Broad Streets change as a north component wind, parallel to Broad Street (0° angle, 11.35° true) changes direction by $\pm 90^{\circ}$ and as a west component wind, parallel to Vine Street (0° angle, 281.35° true), changes direction by $\pm 90^{\circ}$. These wind directions create the highest CO levels. Figure 3 is similar and shows CO levels with south component wind for Broad Street and east component wind for Vine. These wind directions create lower CO levels. Figures 2 and 3 show CO concentrations for specific wind directions. Figure 4 shows when CO levels exceed 9 ppm relative to wind direction and deviation (angle spread). Figure 4 provides information for the worst wind directions and is a refinement of the information provided in Figure 2.

TABLE 1

POTENTIAL CO HOT SPOTS IN PHILADELPHIA CBD - 1983

N-S Street	E-W Street	Parcels
15th	Vine	2
Broad	Vine	39
Broad	Walnut	2
13th	Vine	4
12th	Vine	1
6th	Race	5
City Hall SW		1
City Hall SE		3

Each parcel is 8 X 10 meters in size.

Figure 1

X-Y Display of CO in PPM Broad & Vine Streets - 1983

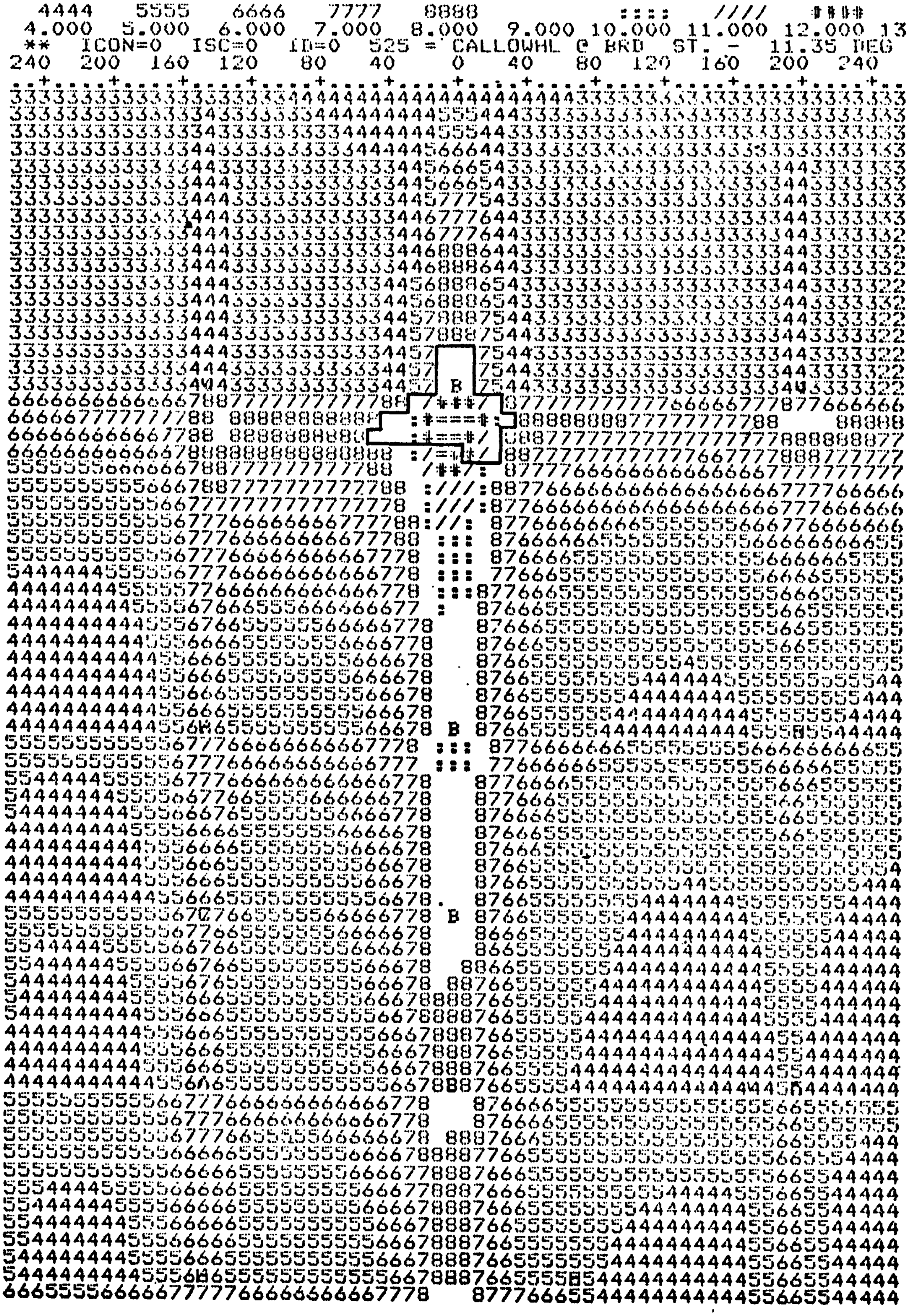


TABLE 2

Average Sidewalk CO Concentrations PPM
Predicted for Broad & Vine Streets - 1983

	Broad Street[1]				Vine Street[2]			
Angle	Compass Direction	CO	Compass Direction	CO	Compass Direction	CO	Compass Direction	CO
-90.0	281.35	7.95	281.35	7.95	191.35	7.40	191.35	7.40
-85.0	286.35	9.03	276.35	7.51	196.35	7.97	186.35	6.88
-80.0	291.35	9.06	271.35	6.89	201.35	8.41	181.35	6.88
-75.0	296.35	8.97	266.35	6.83	206.35	8.81	176.35	6.80
-70.0	301.35	8.64	261.35	6.85	211.35	9.51	171.35	6.89
-65.0	306.35	8.60	256.35	7.02	216.35	9.83	166.35	6.92
-60.0	311.35	7.99	251.35	7.40	221.35	10.17	161.35	7.20
-55.0	316.35	7.89	246.35	7.74	226.35	10.39	156.35	7.53
-50.0	321.35	7.95	241.35	7.98	231.35	11.12	151.35	7.97
-45.0	326.35	8.64	236.35	8.01	236.35	11.90	146.35	8.44
-40.0	331.35	8.86	231.35	7.73	241.35	12.31	141.35	8.96
-35.0	336.35	8.85	226.35	7.43	246.35	12.63	136.35	9.09
-30.0	341.35	8.95	221.35	7.69	251.35	13.02	131.35	10.28
-25.0	346.35	9.16	216.35	7.86	256.35	13.53	126.35	11.04
-20.0	351.35	9.57	211.35	7.92	261.35	14.42	121.35	11.85
-15.0	356.35	10.16	206.35	7.83	266.35	15.30	116.35	12.75
-10.0	1.35	10.65	201.35	7.78	271.35	15.68	111.35	13.11
-5.0	6.35	10.99	196.35	7.10	276.35	15.37	106.35	12.18
-2.0	9.35	10.79	193.35	6.93	279.35	14.57	103.35	11.27
0.0	11.35	10.37	191.35	6.42	281.35	13.55	101.35	10.40
2.0	13.35	9.86	189.35	6.02	283.35	12.84	99.35	9.36
5.0	16.35	8.69	186.35	5.10	286.35	11.25	96.35	7.65
7.5	18.85	7.58	183.85	4.48	288.85	9.56	93.85	6.27
10.0	21.35	6.70	181.35	4.21	291.35	8.08	91.35	4.81
12.5	23.85	6.01	178.85	3.71	293.85	6.83	88.85	3.78
15.0	26.35	5.48	176.35	3.29	296.35	5.91	86.35	2.98
20.0	31.35	4.90	171.35	2.80	301.35	4.77	81.35	2.02
25.0	36.35	5.11	166.35	2.64	306.35	4.40	76.35	1.69
30.0	41.35	4.74	161.35	2.59	311.35	3.84	71.35	1.65
35.0	46.35	5.41	156.35	2.70	316.35	3.96	66.35	1.75
40.0	51.35	5.43	151.35	2.90	321.35	4.12	61.35	2.04
45.0	56.35	5.27	146.35	3.14	326.35	4.46	56.35	2.33
50.0	61.35	5.16	141.35	3.52	331.35	4.41	51.35	2.65
55.0	66.35	5.07	136.35	3.20	336.35	4.13	46.35	2.76
60.0	71.35	5.15	131.35	3.76	341.35	3.85	41.35	2.16
65.0	76.35	5.30	126.35	3.72	346.35	3.68	36.35	2.52
70.0	81.35	5.48	121.35	3.79	351.35	3.42	31.35	2.13
75.0	86.35	5.62	116.35	3.91	356.35	3.60	26.35	2.10
80.0	91.35	5.68	111.35	4.31	1.35	3.89	21.35	2.44
85.0	96.35	5.84	106.35	4.79	6.35	4.27	16.35	3.16
90.0	101.35	4.96	101.35	4.96	11.35	4.06	11.35	4.06

[1] East sidewalk of Broad Street between Race and Vine Streets

[2] North sidewalk of Vine Street between Broad and 13th Streets

Figure 2

1 HR CO(PPM) vs. Wind Angle to Street—1983 Smoothed

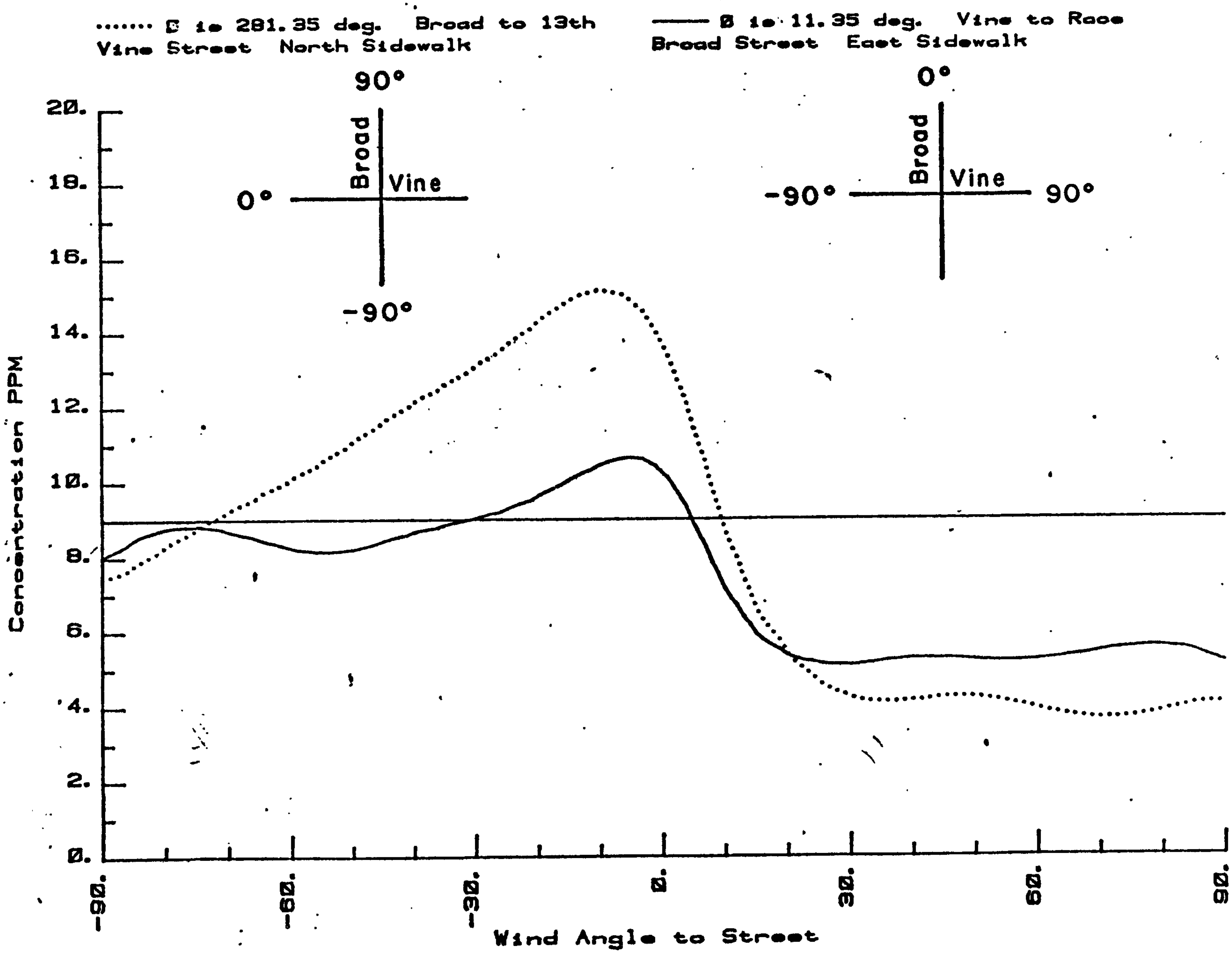


Figure 3

1 HR CO(PPM) vs. Wind Angle to Street—1983 Smoothed

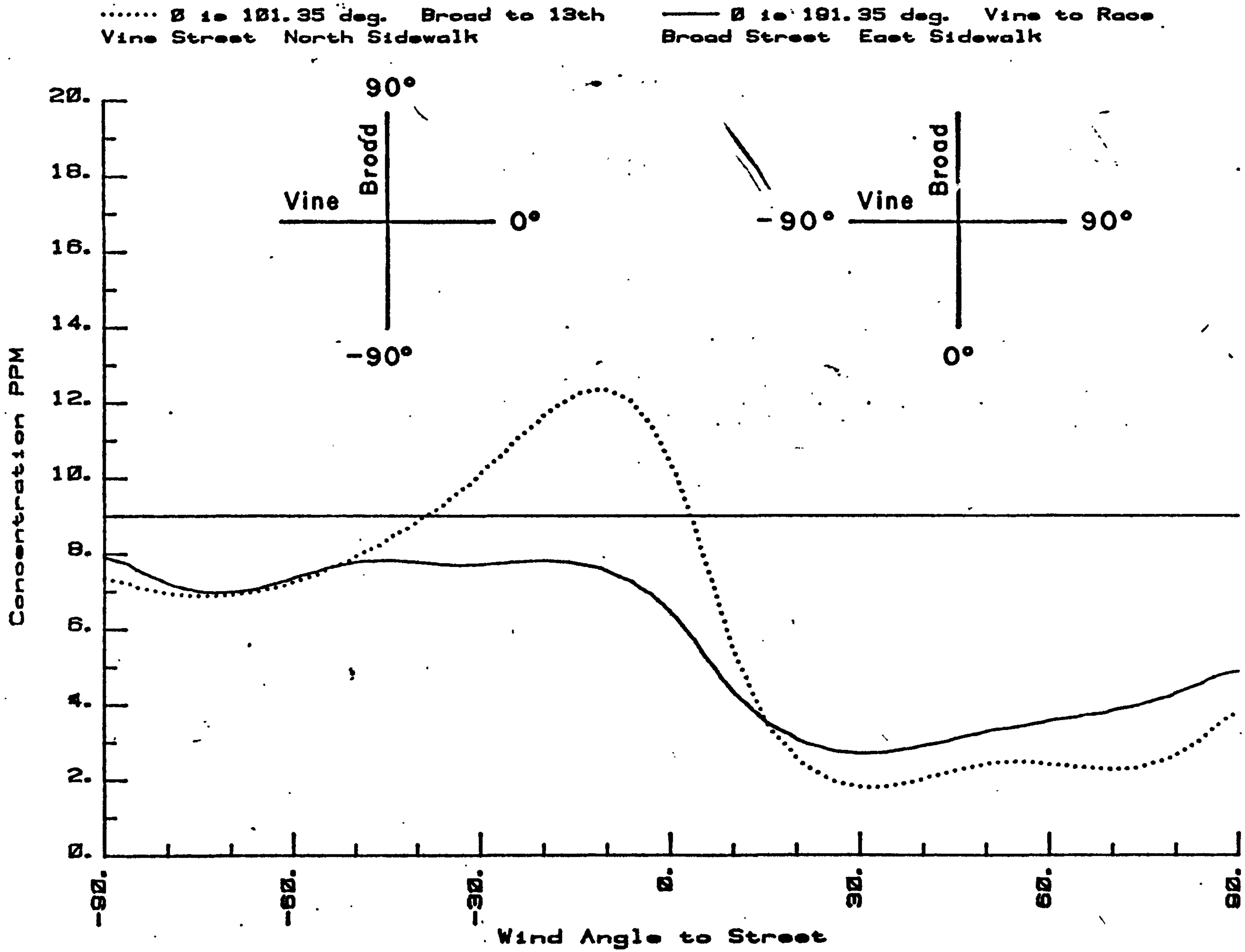
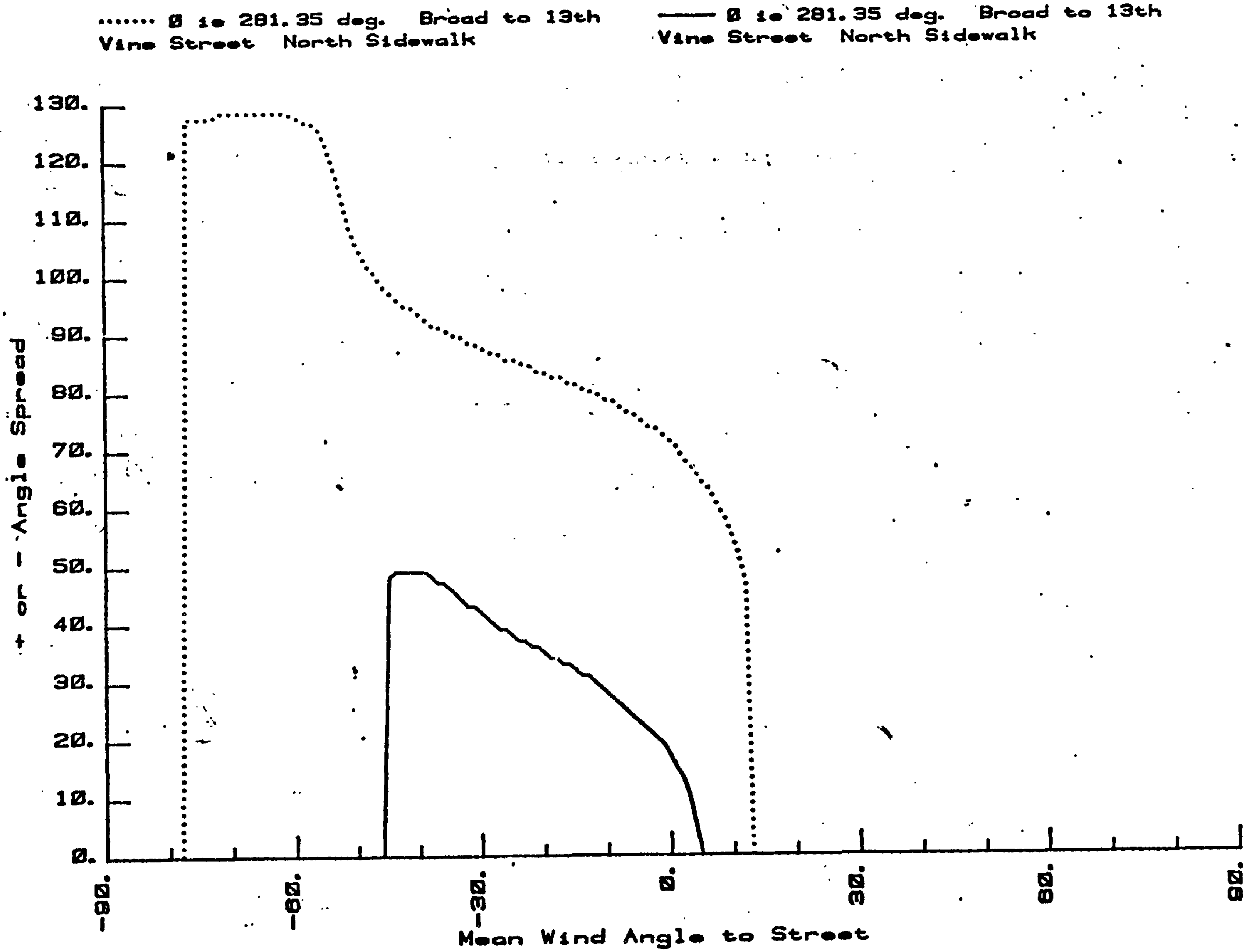


Figure 4
Angle Spread Causing CO to Exceed 9 PPM – 1983



As an example figure 4 shows that, on the east sidewalk of Broad Street if the mean wind direction is -45° (to the left) of 0° (11.35° true) and the wind direction is "evenly distributed" within ±48° from -45° for 8 hours then the mean 8 hour CO concentration will exceed 9 ppm. Likewise, the Vine Street north sidewalk with a mean direction of -77° from 0° (281.35° true) with a wind angle spread of up to -128° will allow the standard to be exceeded. Mean wind angles such as +30° indicates values of 9 ppm and above do not occur.

Only when the wind direction remains within an 87° sector (350° to 77° clockwise) for 8 hours is the standard not expected to be exceeded on the north side of Vine Street. The east side of Broad Street will experience an exceedence when the wind direction is within a 111° sector (278° to 29° clockwise). It must be remembered that this is only true for a wind speed of 1 mps. A similar analysis could have been made for Vine Street's south sidewalk and Broad Street's west sidewalk although estimated CO levels would be less. The above analysis should be sufficient to illustrate the sensitivity of CO levels to wind direction at Broad and Vine Streets.

Vehicular emissions for 1987 were used to determine the 1987 hotspots with the same procedure as was used for 1983. Even though there were values above 9 ppm for the W-E Vine Street wind direction (281.35° true) display, there were none for the N-S Broad Street wind direction (11.35° true) display (fig. 5). Therefore, if the two displays are placed perpendicular to one another, no potential

FIGURE 5
X-Y Display of CO in PPM
Broad & Vine Streets - 1987

```
  4444    5555    6666    7777    8888            ::::    ////    ####
 4.000   5.000   6.000   7.000   8.000   9.000 10.000 11.000 12.000 13
 **  ICON=0  ISC=0  ID=0  525 = CALLOWHL @ BRD  ST. -   11.35 DEG
240   200   160   120   80    40    0    40    80   120   160   200   240
..+....+....+....+....+....+....+....+....+....+....+....+....+..
22222222222222222222222222222223332222222222222222222222222222222
22222222222222222222222222222223332222222222222222222222222222222
22222222222222222222222222222223332222222222222222222222222222221
12222222222222222222222222222223333222222222222222222222222222211
11222222222222222222222222222234443222222222222222222222222222211
11222222222222222222222222222234443222222222222222222222222222111
11122222222222222222222222222234443222222222222222222222222222111
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11122222222222222222222222222234443222222222222222222222222221111
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44444444444455555555555555556678887655555555555555555555565555 5
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32222233333334443333333344444566654443333333333333333333333333333
32222222333334443333333334444566654433333333333333333333333333333
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32222222233334443333333333444555554433333333333333333333333333333
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33222222333334443333333333444555443333333333222222222333332222222
3322222223333 4A4333333333333445B544333333333222222222223 3A3222222
33333333333334444433333344444555554444333333333333333333334333333
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33333333333334444433333334444555554443333333333333333333443333333
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33333333333334443333333333444555544433333333333333333333443333333
33333333333334443333333333444555444333333333333333333333343333322
33333333333334443333333333444555444333333333333333333334433333222
33333333333334443333333333444555443333333333333333333333443332222
33333333333334443333333333444555443333333333333333333333443332222
33333333333334443333333333444555443333333333333333333333443332222
33333333333334H4333333333334455B5443333B33333333323333334433322 22
43333333334444444444444444444555544444433333333222333344333222222
```

hot spots appear. When the average sidewalk concentrations vs. wind direction were compiled for 1987 as for 1983 (Table 2), it was observed that the maximum estimated level for Broad Street was 6.93 ppm at a -5^{o} angle to Broad Street. Vine Street exhibited an estimated 9.90 ppm concentration at a -10^{o} angle to Vine Street. The direction range producing concentrations above 9 ppm appears to occur from 261^{o} to 281^{o}. With a wind speed of 1 mps, it is unlikely that the wind would remain within 20^{o} for an 8 hour period. It is safe to conclude then that for the case of D stability, 1 mps wind speed, all 1983 hot spots in the Philadelphia CBD are eliminated by 1987. However, due to the fact that the wind direction from the West to the SSW occurs 31% of the time and is the most pronounced sector for occurrences of temperature inversions, we expect a number of violations of the 8 hour standard along Vine Street prior to 1987.

CONCLUSIONS

The study identifies eight intersections (Table 1) in the Philadelphia Central Business District where potential violations of the National Ambient Air Quality Standard for carbon monoxide are predicted for 1983. A plot of sidewalk concentrations predicts that only one intersection will remain in violation after 1983. This single violation site, Broad & Vine, is projected to be eliminated prior to 1987 due to changes in the composition of the vehicle fleet and the greatly improved emission characteristics of that 1987 vehicle mix. These predictions hold true both in the case of retaining the currently programmed new vehicle emission reductions and in the case of the administration's proposed revision of the Federal new vehicle emission standards which would hold in place 1980 emission requirements for CO and delay scheduled 1981 CO emission imporvements indenfinitely.

Based on the results of this study, Air Management Services established a continuous carbon monoxide monitor at the identified worst site, Broad & Vine Streets, in late January 1982. The limited data gathered indicates this site has the highest CO levels of any being measured in the city. Air Quality data from this site and others in the city is available for further study.

APPENDIX A

TECHNICAL ASPECTS OF THE MODEL

Model Assumptions

- Inventory file represents near 1983 traffic flow conditions.
- The ground is considered street level (0 elevation) except Vine Street Expressway, Benjamin Franklin Bridge and Schuylkill Expressway.
- Elevation and depression of streets is considered by linear interpolation between height of nodes.
- No street canyon effects are considered with the wind speed of 1 mps.
- Map of concentration plane and emissions are all 2 meters above ground.
- Mixing depth is fixed at 430 meters for D stability (essentially only influences the air quality impact of distant sources).
- Worst case Meteorology required by EPA - D-stability, (10^{o} wind standard deviation), 1m/sec wind speed for 1 hour out of the 8AM-4PM period.
- Predictions are never made within the street but are limited to no closer than 6 feet from curb (½ mean sidewalk width) or 1 meter downwind from a cell.

Diffusion Parameter Calculations

- Downwind σ_y is estimated by FUQUAY Calculations.
- Initial σ_z = 5 meters
- Initial σ_y = 3 meters

- Downwind σ_z is found by multiplying FUQUAY's σ_y with Pasquill-Gifford's σ_z / σ_y ratio D stability at a given X distance.
- The σ_z multiple reflection term is included (seven iterations).
- Tabular values of multiple reflection terms, σ_z and σ_y are calculated for 350 logarithmically spaced downwind distances (1m to 100 km) for streets at 0m height.

Mobile Source CO Emission Factors

- 1983 Composite Emission factors are from Mobile II at 25°F, 18% idle time, and 20% cold catalytic, 20% cold non-catalytic, 28% hot catalytic starts.
- Vehicle mix contains 9% trucks
- I&M starting in 1982 with 20% stringency level and Mechanic Training
- Estimates are corrected for the speed on each street segment

Recommendations for Improvement

- Allow initial σ_z to become proportional to vehicle speed
- Allow downwind σ_z to be dependent on vertical temperature gradient
- Make σ_θ (Standard deviation of wind direction) dependent on wind angle to road (building eddies effect).
- Incorporate actual queueing
- Vary realistic worse case stability classifications and wind speeds for 8 hr. estimates.

APPENDIX B
TRAFFIC DATA

CBD

Presented is a sample of the data file that was assembled for input to the model. The traffic volume figures were collected over a two year period to supplement existing counts made by the Philadelphia Department of Streets. No volume data is older than 1977. Measurement of vehicle seconds of delay at each intersection was made for this study to characterize the average idle time experienced at individual intersections. In addition, the travel time between intersection center lines was measured during morning and afternoon peak hours. Model predictions were based on Mobile II vehicle emission factors calculated for 18% idle and 25°F ambient temperature. These figures are considered a representative condition for the study area since each vehicle will stop, on average, at one of every three intersections encountered. The direction of the street relative to the wind, average vehicle speed, emissions in grams/second and street length are calculated based on this data file.

Area Sources

Area source information is included in the file in a format similar to that for the CBD. There are 15 area sources covering the 11 county region, each is rectangular in shape and each was considered to originate from the center of the county or sub area of Philadelphia for which total areawide VMT was provided by DVRPC.

NODE DATA FILE

COL.	FORMAT	VARIABLE	COMMENT
1	13	Node	node number
4 9	F5.2 F5.2	Xg Yg	x + y coordinates generated from a 1"=400 Ft. map; hundreths of inches
16	A1	Loc	street map print character (located at street intersections)
18	2A4	Name	name of east-west Street
27	F4.0	PM	vehicle/hr. PM peak - not used
31	F4.0	AM	vehicle/hr. AM peak - not used
35	F4.0	Hr8	average vehicles/hr. from max 8 hr. period (east-west)
40	F3.0	SW	street width, ft. (east-west)
43	F4.0	Sec	travel time to next Node, Sec. (east-west)
48	13	Nodw	Node # to west
52	13	Nodn	Node # to north
57	2A4	Name	name of north-south Street
65	F4.0	PM	vehicle/hr. PM peak - not used
69	F4.0	AM	vehicle/hr. AM peak - not used
73	F4.0	Hr8	average vehicle/hr. from max 8 hr. period (north-south)
78	F3.0	SW	street width, ft. (north-south)
81	F4.0	Sec	travel-time to next Node, sec (north-south)
86	F3.0	Tz	topographic height, ft. relative to ground level value is usually zero
89 94	F5.2 F5.2	XGE YGE	1. X+Y coordinates at the end of the area source (given in file) 2. Program searches for matching Nodw on Nodn with Node, Xg, Yg - XGE, YGE for streets

SAMPLE OF NODE DATA FILE

```
''''/''''1''''/''''2''''/''''3''''/''''4''''/''''5''''/''''6''''/''''7''''/''''8

 29 2975   00  I BAINGRIG     0   0   0   0  -1 -99 389 I95              2900 150  58 -17
 32   51   74  S SOUTH         0   0   0   0  -1 -99  62 27TH ST.  716 871 586  26  17
 33  140   74  S SOUTH       280   0 551  27  19  32  63 26TH ST.   69  42  29  20  30
 34  211   74  S SOUTH       280   0 551  27  13  33  64 25TH ST.    0   0 116  26  30
 35  294   74  S SOUTH       280   0 435  27  18  34  65 24TH ST.    0   0  58  26  30
 36  379   74  S SOUTH       280   0 435  27  10  35  66 23RD ST.  358 310 240  26  16
 37  462   74  S SOUTH       605 720 480  27  19  36  67 22ND ST.  750   0 342  33  17
 38  575   74  S SOUTH       410   0 394  27  15  37  68 21ST ST.  400   0 238  26  14
 39  710   74  S SOUTH       414 477 410  27  21  38  69 20TH ST.  366 359 280  26  21
 40  828   74  S SOUTH       382 386 330  27  20  39  70 19TH ST.  319 274 240  26  23
 41  937   74  S SOUTH       379   0 313  27  21  40  71 18TH ST.  367 446 280  26  16

''''/''''1''''/''''2''''/''''3''''/''''4''''/''''5''''/''''6''''/''''7''''/''''8

 42 1050   74  S SOUTH       345 334 320  27  20  41  72 17TH ST.  290   0 174  26  16
 43 1160   74  S SOUTH       400   0 273  27  26  42  73 16TH ST.  298   0 232  26  19
 44 1277   74  S SOUTH       400   0 273  27  14  43  74 15TH ST.  220   0 145  26  23
 45 1396   74  B SOUTH       395 275 300  27  19  44  75 BRD  ST    0   01363  69  14
 46 1557   74  S SOUTH       421 311 350  27  17  45  76 13TH ST.  351 329 230  26  22
 47 1670   74  S SOUTH       334 333 320  26  15  46  77 12TH ST.  380   0 278  26  20
 48 1779   74  S SOUTH       275   0 232  26  17  47  78 11TH ST.  251   0 197  26  19
 49 1896   74  S SOUTH       260 302 230  27  17  48  79 10TH ST.  400   0 232  26  20
 50 2006   74  S SOUTH       290   0 220  27  21  49  80  9TH ST.  244 260 200  26  16
 51 2118   74  S SOUTH       373 277 300  27  17  50  81  8TH ST.  240   0 284  26  16
 52 2239   74  S SOUTH       347 268 300  27  20  51  82  7TH ST.  434 422 350  26  14

''''/''''1''''/''''2''''/''''3''''/''''4''''/''''5''''/''''6''''/''''7''''/''''8

 53 2347   74  S SOUTH       263 204 230  26  22  52  83  6TH ST.  364   0 232  26  14
 54 2460   74  S SOUTH       260   0 174  27  22  53  84  5TH ST.  228   0 180  26  19
 55 2576   74  S SOUTH       355 353 300  26  24  54  85  4TH ST.  228   0 220  26  28
 56 2685   74  S SOUTH       290   0 226  27  27  55  86  3RD ST.  435 450 360  26  18
 57 2826   74  S SOUTH       163 164 150  27  22  56 -99  2ND ST.    0   0   0   0  -1
 62   51  163  L LOMBARD       0   0   0   0  -1 -99 -99 27TH ST.    0   0   0   0  -1
 63  140  163  L LOMBARD     565   0 586  26  10  62  93 26TH ST.  192  84  58  20  30
 64  211  163  L LOMBARD     565   0 586  26  15  63  94 25TH ST.   50   0 116  26  20
 65  294  163  L LOMBARD     362 335 406  26  17  64  95 24TH ST.  309 174 174  26  30
 66  379  163  L LOMBARD     362 335 284  26  11  65  96 23RD ST.  499 466 320  26  13
 67  462  163  L LOMBARD     565   0 278  26  16  66  97 22ND ST.  893 923 680  33  16

''''/''''1''''/''''2''''/''''3''''/''''4''''/''''5''''/''''6''''/''''7''''/''''8

 68  575  163  L LOMBARD     711 519 540  26  15  67  98 21ST ST.  390   0 232  26  23
 69  710  163  L LOMBARD     777 516 580  26  16  68  99 20TH ST.  459 331 300  26  20
 70  828  163  L LOMBARD     598 487 500  26  16  69 100 19TH ST.  310 256 230  26  27
 71  937  163  L LOMBARD     817 537 630  26  17  70 101 18TH ST.  316   0 261  26  14
```

APPENDIX C
AIR MONITORING DATA

Presented here is data collected by Air Management Services at three continuous air monitoring stations located in Philadelphia's Central Business District.

<u>ASY</u> - Arch Street midblock between Broad & 15th Streets

<u>FRI</u> - Race Street midblock between 20th & 21st Streets

<u>SBR</u> - Spruce Street 30 meters East of Broad Street (Between Broad & 13th Streets)

All monitor sample inlet locations are one meter horizontally from the building line and 3.35 meters in elevation.

<u>ASY</u> - began operation 1/80

Air Management Services
City of Philadelphia
1980

Ranking of Daily Maximums

FRI HR	FRI DATE	FRI AVG	SBR HR	SBR DATE	SBR AVG	ASY HR	ASY DATE	ASY AVG
0	2/20/80	5.9	8	10/16/80	8.0	8	10/16/80	8.2
8	12/16/80	4.9	8	12/24/80	7.5	16	3/ 7/80	7.0
8	10/16/80	4.7	8	10/15/80	6.8	8	9/19/80	7.0
16	3/ 7/80	4.5	8	5/12/80	6.3	8	11/14/80	6.9
16	12/ 1/80	4.5	16	10/11/80	5.9	8	8/ 1/80	6.8
8	12/23/80	3.6	16	10/14/80	5.8	16	12/ 5/80	6.8
16	5/19/80	3.3	16	8/19/80	5.6	8	7/21/80	6.6
16	4/18/80	3.1	16	1/18/80	5.4	8	6/ 3/80	6.5
0	11/ 3/80	3.1	16	12/ 1/80	5.4	8	7/ 3/80	6.5
16	10/11/80	3.0	8	12/23/80	5.4	8	8/27/80	6.5
0	10/15/80	3.0	16	3/ 7/80	5.3	8	8/28/80	6.5
8	1/11/80	2.8	16	2/19/80	5.1	8	8/23/80	6.4
8	1/14/80	2.8	8	12/ 8/80	5.0	8	9/22/80	6.4
16	1/16/80	2.8	16	12/22/80	4.9	8	12/ 6/80	6.3
16	11/ 9/80	2.6	16	7/ 3/80	4.8	8	2/20/80	6.0
16	12/31/80	2.6	8	7/16/80	4.5	8	7/17/80	6.0
8	5/20/80	2.6	8	8/25/80	4.5	16	10/ 3/80	6.0
16	5/ 4/80	2.5	16	12/ 7/80	4.5	16	11/20/80	6.0
16	12/27/80	2.5	16	12/ 5/80	4.4	16	11/21/80	6.0
16	4/30/80	2.4	8	2/20/80	4.3	8	5/23/80	5.9
8	12/24/80	2.4	16	1/25/80	4.1	8	7/31/80	5.9
8	12/29/80	2.4	16	8/23/80	4.1	8	8/15/80	5.9
8	1/10/80	2.3	16	11/20/80	4.1	16	9/ 6/80	5.9
16	1/18/80	2.3	16	1/10/80	4.0	8	11/15/80	5.9
16	1/25/80	2.3	8	7/11/80	4.0	8	8/26/80	5.8
0	6/ 6/80	2.3	16	7/26/80	4.0	8	10/11/80	5.8
0	11/23/80	2.3	8	11/28/80	4.0	8	11/ 1/80	5.8
16	2/ 6/80	2.1	8	5/23/80	3.9	8	11/ 7/80	5.8
8	12/ 8/80	2.1	16	11/24/80	3.9	16	12/ 1/80	5.8
16	12/15/80	2.1	8	9/ 5/80	3.9	16	11/19/80	5.7
16	12/18/80	2.1	8	5/ 6/80	3.8	16	4/23/80	5.6
16	2/25/80	2.0	16	1/ 8/80	3.8	8	5/ 6/80	5.6
8	5/12/80	2.0	16	4/18/80	3.8	16	7/11/80	5.6
16	9/27/80	2.0	16	7/25/80	3.8	8	9/18/80	5.6
16	10/30/80	2.0	8	8/18/80	3.8	8	9/27/80	5.6
16	2/22/80	1.9	16	11/14/80	3.8	8	10/28/80	5.6
16	4/29/80	1.9	8	11/21/80	3.7	16	11/13/80	5.6
8	2/21/80	1.8	8	9/12/80	3.7	8	7/23/80	5.5
16	11/14/80	1.8	16	5/ 2/80	3.6	8	8/25/80	5.5
0	11/21/80	1.8	16	5/ 9/80	3.6	8	10/ 9/80	5.5
16	12/ 9/80	1.8	16	6/ 7/80	3.6	16	12/23/80	5.5
8	10/27/80	1.7	8	9/19/80	3.6	8	7/ 9/90	5.4
16	1/15/80	1.6	16	10/10/80	3.6	16	10/14/80	5.4
16	3/31/80	1.6	16	5/ 1/80	3.5	16	10/21/80	5.4
8	9/19/80	1.6	16	5/16/80	3.5	16	10/30/80	5.4
16	10/ 3/80	1.6	16	5/22/80	3.5	8	10/31/80	5.4
16	11/22/80	1.6	16	6/25/80	3.5	16	1/ 7/80	5.3
8	12/22/80	1.6	16	10/17/80	3.5	16	1/22/80	5.3
8	8/28/80	1.6	16	10/30/80	3.5	8	7/18/80	5.3
8	3/17/80	1.5	16	12/11/80	3.5	8	7/25/80	5.3

Air Management Services
City of Philadelphia
1981

Ranking of Daily Maximums

FRI HR	FRI DATE	FRI AVG	SBR HR	SBR DATE	SBR AVG	ASY HR	ASY DATE	ASY AVG
16	11/ 4/81	9.5	16	11/ 3/81	7.3	16	11/ 3/81	10.4
16	11/ 3/81	9.0	8	11/20/81	7.0	8	11/20/81	9.5
16	12/25/81	5.8	8	11/17/81	6.9	8	8/14/81	8.7
0	11/ 5/81	5.6	16	11/ 4/81	5.8	8	11/17/81	8.3
8	11/20/81	5.3	0	11/ 5/81	5.6	16	11/ 4/81	8.0
16	11/30/81	5.3	16	11/ 5/81	5.5	8	2/24/81	7.1
0	12/31/81	5.3	8	11/ 5/81	5.4	16	9/25/81	6.9
16	1/14/81	5.1	16	11/19/81	5.1	8	6/ 5/81	6.8
0	12/26/81	5.1	8	12/17/81	5.0	16	9/11/81	6.6
0	6/24/81	4.9	16	11/ 2/81	4.9	8	11/ 4/81	6.6
16	10/ 5/81	4.9	8	10/ 6/81	4.9	16	10/ 5/81	6.5
0	10/ 6/81	4.9	16	1/ 9/81	4.8	16	3/31/81	6.3
0	3/26/81	4.6	16	10/ 5/81	4.8	8	9/11/81	6.3
0	12/ 1/81	4.6	16	12/ 7/81	4.8	8	7/ 9/81	6.1
0	10/15/81	4.4	8	1/16/81	4.6	16	3/20/81	6.1
16	1/ 9/81	4.1	16	1/16/81	4.6	16	10/15/81	6.1
16	11/13/81	4.1	16	4/23/81	4.6	8	12/ 2/81	6.1
8	11/17/81	4.1	16	10/15/81	4.6	8	5/29/81	6.0
16	3/31/81	4.0	16	11/17/81	4.6	8	6/ 4/81	6.0
0	10/13/81	4.0	16	11/20/81	4.6	8	8/12/81	6.0
16	10/13/81	4.0	8	10/23/81	4.4	8	8/ 3/81	5.9
0	2/ 1/81	3.9	8	11/ 2/81	4.4	8	9/15/81	5.9
0	2/ 7/81	3.9	0	10/ 6/81	4.4	16	11/30/81	5.9
16	4/27/81	3.9	16	12/ 3/81	4.4	16	12/ 4/81	5.9
16	4/23/81	3.8	8	9/15/81	4.3	16	2/17/81	5.8
0	10/11/81	3.6	8	12/15/81	4.3	16	4/23/81	5.8
8	10/13/81	3.6	0	6/30/81	4.3	8	10/ 6/81	5.8
0	10/16/81	3.6	8	11/ 4/81	4.2	16	11/ 2/81	5.8
16	12/ 4/81	3.6	8	10/21/81	4.1	8	7/21/81	5.6
8	11/ 5/81	3.6	16	6/29/81	4.1	8	9/ 9/81	5.6
0	1/ 9/81	3.5	16	9/11/81	4.1	8	12/14/81	5.6
16	9/25/81	3.5	16	12/17/81	4.1	8	7/ 8/81	5.6
0	11/24/81	3.5	16	1/14/81	4.0	16	3/30/81	5.5
16	1/31/81	3.4	16	6/ 7/81	4.0	8	4/23/81	5.5
16	10/15/81	3.4	16	9/25/81	4.0	8	8/13/81	5.5
8	10/15/81	3.3	16	10/ 1/81	4.0	16	12/ 7/81	5.5
8	6/18/81	3.3	8	10/15/81	4.0	8	2/18/81	5.4
8	12/31/81	3.3	8	12/ 1/81	4.0	8	9/ 4/81	5.4
8	11/24/81	3.1	8	12/14/81	4.0	8	10/15/81	5.4
8	4/23/81	3.1	8	1/ 9/81	3.9	8	10/26/81	5.4
8	12/ 4/81	3.1	0	2/ 1/81	3.9	8	11/ 5/81	5.4
0	2/28/81	3.0	16	3/31/81	3.9	8	11/ 9/81	5.4
16	6/20/81	3.0	16	8/12/81	3.9	16	1/14/81	5.3
0	11/ 4/81	3.0	16	10/17/81	3.9	8	6/ 6/81	5.3
8	12/ 1/81	3.0	16	11/30/81	3.9	8	7/ 7/81	5.3
8	12/14/81	3.0	8	8/26/81	3.9	8	8/ 4/81	5.3
16	12/14/81	3.0	8	11/ 9/81	3.9	16	9/ 9/81	5.3
16	12/22/81	3.0	8	10/27/81	3.8	8	10/23/81	5.3
16	5/29/81	2.9	8	7/17/81	3.8	8	2/17/81	5.1
8	10/ 6/81	2.9	16	12/ 2/81	3.8	8	4/24/81	5.1

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FURTHER ANALYSIS OF CENTER CITY CARBON MONOXIDE LEVELS

Based on the assumptions made in the Philadelphia Center City Carbon Monoxide Study it appeared that the NAAQS of 9 ppm for an 8 hour period would be satisfied by 1987. In response to a request from EPA, a more detailed examination of 1985 and 1987 predicted air quality was made. Persistency of the wind is critical to the estimated concentrations and was therefore the main area of review.

Calculations for 1985 revealed that if the hourly wind direction remained within a 40 degree range during 8 hours with the other worst case meteorological conditions specified by EPA, the NAAQS standards would be exceeded. No further evaluation for 1985 seemed necessary.

Since 1987 appeared as the first possible year to attain the standard, mean sidewalk calculations were predicted for 1 degree and 2.5 degree wind direction intervals from -25 degrees South of Vine (281.35 degrees true) to 20 degrees North of Vine. The remaining directions were considered at 5 degree intervals. This eliminated the need for the smoothing technique incorporated in the Philadelphia Center City Carbon Monoxide Study. Since the directional range required to exceed the 1987 standard was approximately 20 degrees, according to the previous study, which averaged equally distributed directions, it would be more accurate if the calculated concentrations would be weighted by a normal curve distribution. The problem is to then determine a representative persistency of the wind that may occur for an 8 hour period within that suspected directional range of high predicted CO. The statistical term for this would be the "standard deviation of the mean" for 8 consecutive hourly mean directions, commonly called the "standard error".

Meterological data collected by Air Management Services includes a standard deviation of the wind direction based on 60 instantaneous readings per hour as well as the mean direction, vector direction and velocity. Seven periods of persistent wind direction within a range of 260-275 degrees were evaluated for the period January 1978 to mid-1981. The months of June-August were eliminated since consideration was made for the colder weather synoptic features necessary to produce a mean temperature of 25 degrees, the chosen worst case conditions. These wind readings were obtained 23 feet above ground at the Fire Boat Station at Delaware and Allegheny Avenue.

The mean 8 hour moving average of the standard deviation $\overline{\sigma}_{\theta}$ was 18.8 degrees while the mean 8 hour moving standard deviation of the hourly mean vector directions $\sigma_{\overline{\theta}}$ was 7.2 degrees. However, since the mean wind velocity was 8.1 mph, it was determined to examine only the 8 hour period with the lowest 8 hour mean wind velocity which was 3.5 mph. The corresponding $\overline{\sigma}_{\theta}$ was 16.13 degrees and $\sigma_{\overline{\theta}}$ was 5.8 degrees. Since $\overline{\sigma}_{\theta}$ was determined at an elevation of 23', a height correction factor was needed. The mean wind profile exponent of .1737 was determined for "D" stability class based upon 2050 rabal soundings in Philadelphia (1969-1975 taken weekdays at 6 am and 11 am local time). This converts 3.5 mph at 23' to 2.77 mph at 6'. Also, the corresponding standard deviation would behave inversely so a $\overline{\sigma_\theta}$ of 16.13 degrees at 23' increases to 20.36 degrees at 6'. The 2.77 mph rounds to 1 mps so the choice of wind velocities seems valid. Since the reduced $\overline{\sigma_\theta}$ of 20.36 degrees is twice the value desired, a relationship between $\overline{\sigma_\theta}$ and $\sigma_{\bar{\theta}}$ must be established.

Using the original wind persistent periods, a cross correlation regression of 138 values of $\overline{\sigma_\theta}$ and $\sigma_{\bar{\theta}}$ gives an R of .59 Even though this is a poor correlation, a substitution of the corresponding regression formula indicates that a $\sigma_{\bar{\theta}}$ needed for a $\overline{\sigma_\theta}$ of 10 degrees is -3.2 degrees. This condition is impossible but indicates that a 10 degree standard deviation of wind direction for 8 consecutive hours may not occur with light winds.

A more realistic approach is to examine the total variation of wind direction during the 8 consecutive hours. A useful formula was derived for this purpose. Using the variance working formula $\sigma^2 = \overline{\theta_8^2} - \overline{\theta_8}^2$ where θ_8 represents the direction for each minute for 8 hours and $\sigma_\theta^2 = \overline{\theta^2} - \overline{\theta}^2$ where σ_θ is the one hour standard deviation of wind direction, then $\sigma^2 = \overline{\sigma_\theta^2} + \sigma_{\bar{\theta}}^2$ where $\overline{\sigma_\theta^2}$ represents the average for 8 hours and σ_θ^2 for 1 hour. $\sigma_{\bar{\theta}}^2$ is the variance of the hourly direction means for 8 hours. For all 138 moving 8 hours, the mean $\overline{\sigma_\theta^2}$ accounted for 87% of the total variance. Meteorologically, this could be stated that the mechanical and thermal turbulence accounted for 87% of the variance while the mean hourly wind direction fluctuations ($\bar{\theta}$) caused by a variation in resultant pressure gradient flow (isobaric orientation) accounted for 13% of the total variation. This method could be used to identify blocking pressure patterns. Using the chosen 8 hour sample, the standard deviations accounted for 89% of the total variance of 305.3. Assuming this is the worst case variance observed for 8 hours during a light wind episode, then σ_θ can be "forced" at 10 degrees for each hour. Letting σ^2 = 305.3 and since $\overline{\sigma_\theta^2}$ = 100, $\sigma_{\bar\theta}$ becomes 14.3 degrees. Using the height adjustment wind profile formula, $\sigma_{\bar\theta}$ decreases 4% due to an increased σ_θ for all 8 hours. Again, letting σ_θ = 10 degrees for 8 hours yields a $\sigma_{\bar\theta}$ of 19.2 degrees. Considering that the wind velocity must be slightly less to approach 1 mps (2.24 mph), a corresponding increase in actual standard deviations would cause a larger total variance for 8 hours, hence σ_θ at 10 degrees would allow an even larger $\sigma_{\bar\theta}$. A most interesting fact is that $\sigma_{\bar\theta}$ appears to be twice as large when using actual 1 hour average directions rather than vector directions. Since vector directions are weighted by velocity, it reflects directions with higher wind velocities. However, atmospheric dispersion in this case with near ground sources is inversely proportional to wind speed. An inverse weighted vector may be more correct than even an unweighted velocity (average direction). Choosing a value of 15 degrees for $\sigma_{\bar\theta}$ would be most conservative. Using this value, no calculated 8 hour CO of 9.0 ppm or above was predicted by the end of 1987. Using strip charts at the Broad and Vine Street monitor, 9 ppm would be interpreted if the worst case wind direction was within 252 degrees to 270 degrees for the 8 consecutive hours. It then appears likely that the NAAQS standards would be met by the end of 1987 and most likely during the first few months of 1987 if the following conditions are met.

1. The EPA estimate of worst case meteorological

conditions are representative.

2. The weatner systems would not become more persistent in the particular direction of mean 260 - 270 degrees during 1987 than examined.

3. Traffic volume and average speed near Broad & Vine are the same in 1987 as projected.

4. Projected MOBILE2 emission factors for 1987 are accurate.

5. Inspection maintenance will be operative in 1983.

Data received at Broad & Vine for January through early November 1982 indicates at least 6 periods of 8 hour values above 9ppm. The highest one-hour CO model prediction for the monitor location for 1983 is 18.5 ppm. Two 19 ppm values were recorded during 18 November 1982.